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VACCINATION OF EWES AGAINST "PULPY KIDNEY" (INFECTIOUS ENTEROTOXAEMIA) IN LAMBS.

FURTHER TRIALS IN OTAGO AND SOUTHLAND, SEASON 1936.

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IN the May, 1936, issue of the *N.Z. Journal of Agriculture*, a summary of the results of the experimental work carried out in Central Otago in the 1935 season was given. This consisted in the vaccination of ewes with a formalized enterotoxæmia (clostridium Welchii, Type D) vaccine, with the object of transferring antitoxic immunity from the ewe to the lamb.

Reference to this article will show that the results obtained justified the trials, and there appeared to be encouraging support to the possibility of the successful vaccination of ewes under practical conditions in the field as a means of minimizing the losses from "pulpy kidney" in lambs.

These field results were further supported by work which had been undertaken in Australia, the results of which were published by D. T. Oxer in the April, 1936, issue of the *Australian Veterinary Journal*. It was clearly demonstrated, by careful laboratory technique, that the usual prophylactic vaccination of ewes against enterotoxæmia is followed in most cases by a marked response, as judged by the antitoxic titre of the blood serum, but it was found that there is considerable variation in the response of different individuals. Also, that the antitoxic immunity developed by the ewe is transmitted to the lamb via the colostrum (first milk).

Oxer concludes, "We are unable to say what degree of immunity would have to be acquired by the lamb before it was protected from the natural infection. It appears probable, however, that a large percentage of lambs would be protected during the first three weeks of life, although it is realized that this can only be determined satisfactorily by extensive trials in the field."

Herein are recorded the results of further vaccination trials which have been carried out in the field in various parts of Otago and Southland during the 1936 season.

In all, 2,608 ewes were vaccinated with a vaccine prepared at the Department's Veterinary Laboratory, Wallaceville. In addition,

observations were maintained on a group of 1,141 ewes which were vaccinated by farmers, in some cases with our help, with a commercial enterotoxæmia vaccine purchased from the Commonwealth Serum Laboratories, Royal Park, Victoria.

In the former case the first dose of vaccine (5 c.c.) was given approximately six weeks before lambing and the second dose (10 c.c.) approximately ten days before lambing.

In the latter case the dose recommended for the first vaccination was 3 c.c., followed by a second dose of 7 c.c. four weeks later. Owing to the fact that the vaccine was not procured in time the four-week interval was not strictly followed, and probably insufficient time elapsed between the second dose and the commencement of lambing.

In all cases a suitable number of control ewes were reserved, which, with the vaccinated ewes, were depastured together. The particulars are given in the following tables :—

Table I.—Vaccine prepared at the Veterinary Laboratory, Wallaceville. (First dose, 5 cc. ; second dose, 10 c.c.)

District and Farm.	Ewes vaccinated.	Ewes (Control).	Date of First Vaccination.	Date of Second Vaccination.
Ranfurly—				
A	326	325	27/8/36	19/9/36
B	175	175	27/8/36	17/9/36
C	150	150	24/8/36	15/9/36
D	101	100	28/8/36	17/9/36
E	274	226	25/8/36	16/9/36
F	620	650	26/8/36	18/9/36
G	217	217	25/8/36	16/9/36
Middlemarch—				
H	158	105	3/8/36	21/8/36
I	156	122	3/8/36	21/8/36
Otautau—				
J	215	215	30/7/36	22/8/36
Mossburn—				
K	107	106	4/8/36	15/9/36
L	109	109	4/8/36	15/9/36
Totals ..	2,608	2,500	..	..

Table II.—The Losses from Pulpy Kidney up to 30th November, 1936, by which Date Mortality had ceased generally, are shown.

Farm.	Vaccinated Group.	Lamb Deaths from Pulpy Kidney.	Control Group.	Lamb Deaths from Pulpy Kidney.	Remarks.
A ..	326	2	325	9	Total losses from pulpy kidney on farm 11 out of 1,150 ewes.
B ..	175	1	175	7	Total losses from pulpy kidney on farm 17 out of 650 ewes.
C ..	150	0	150	1	Total losses from pulpy kidney on farm 22 out of 1,030 ewes.
D ..	101	2	100	2	Total losses from pulpy kidney on farm 18 out of 740 ewes.
E ..	274	0	226	0	Total losses from pulpy kidney on farm 13 out of 690 ewes.

Table II—continued.

Farm.	Vaccinated Group.	Lamb Deaths from Pulpy Kidney.	Control Group.	Lamb Deaths from Pulpy Kidney.	Remarks.
F ..	620	2	650	29	Total losses from pulpy kidney on farm 36 out of 1,500 ewes. One wether lamb in vaccinated group included, dead day after marking, doubtful if pulpy kidney.
G ..	217	0	217	4	Total losses from pulpy kidney on farm 20 out of 1,260 ewes.
H ..	158	0	105	17	Losses in previous years stated to be in the vicinity of 10 per cent. Lambing percentage this year 127 per cent., and total loss on farm from pulpy kidney 45 to 50 lambs.
I ..	156	1	122	8	Total losses from pulpy kidney this year 18. Last year, lost 75 lambs, was worst season experienced. Owner says up to this season average 10-per-cent. loss.
J ..	215	0	215	0	Position unusual, losses generally exceed 5 per cent. One lamb was lost from control group, but doubtful if pulpy kidney.
K ..	107	0	106	3	Death-rate from pulpy kidney in past years, 4 per cent. to 10 per cent.
L ..	109	0	109	4	Seven lambs actually died here, but owing to the ewes leaving the dead lambs it was only possible to identify four lambs which were definitely from control ewes. Usual death-rate is from 2 per cent. to 3 per cent.
Totals	2,608	8	2,500	84	

In the vaccinated group of ewes the pulpy kidney losses among lambs were 8 = 0·306 per cent. In the control group of ewes the pulpy kidney losses among lambs were 84 = 3·36 per cent.

Table III.—Vaccine obtained by the Farmers from the Commonwealth Serum Laboratories, Melbourne. (First dose, 3 c.c.; second dose, 7 c.c.)

Farm.	Ewes vaccinated.	Ewes (Control).	Date of First Vaccination.	Date of Second Vaccination.
M	377	1,473	17/8/36	2/9/36
N	182	182	18/8/36	10/9/36
O	186	186	18/8/36	10/9/36
P	396	434	Group 1 15/8/36	12/9/36
			Group 2 28/8/36	23/9/36
Totals ..	1,141	2,275	..	..

Table IV.—The Losses from Pulpy Kidney up to 30th November, 1936, in Lambs from Ewes in Table III.

Farm.	Vaccinated Group.	Lamb Deaths from Pulpy Kidney.	Control Group.	Lamb Deaths from Pulpy Kidney.	Remarks.
M ..	377	5	1,473	69	Owing to being unable to procure the vaccine in time the ewes were vaccinated closer to lambing than desirable.
N ..	182	1	182	4	Previous losses on farm about 5 per cent.
O ..	186	3	186	4	Previous losses on farm about 5 per cent.
P ..	396	13	434	7	The vaccinated ewes were four and five years old, whereas the majority of the controls were two-tooths.
Totals	1,141	22	2,275	84	

In the vaccinated group of ewes the pulpy kidney losses among lambs were 22 = 1·92 per cent.

In the control group of ewes the pulpy kidney losses among lamb were 84 = 3·68 per cent.

Technique of Vaccination.

The most suitable place to handle the ewes for vaccination is in a drafting-race, into which the ewes are run, filling the race without unnecessarily crushing the sheep. Vaccination is then commenced, and the operator and his assistant work along the whole race, leaning over from outside the race.

The site of injection found suitable is behind the shoulder; this allows the minimum of handling, the ewes standing on all four limbs practically unrestrained. The wool behind the shoulder and the site of injection is thus exposed for the operator; this is quickly cleansed with a swab of cotton-wool soaked in methylated spirit. A 20 c.c. Record hypodermic syringe is used for the injection, and the needle is inserted obliquely, keeping the barrel of the syringe more or less parallel to the body of the ewe, through the skin and the subcutaneous fascia, then the required dose is introduced subcutaneously by pressure on the plunger of the syringe.

At the commencement of the work the syringe is sterilized by boiling. It is important to remove the plunger from the barrel of the syringe. The portions are then placed in the cold water, which is brought to the boil and retained so for ten minutes. The needles are kept handy in a suitable vessel containing methylated spirit.

The vaccine is kept in its original container, the cork being removed and a piece of sterlized rubber tied over the opening; through this the needle of the syringe is inserted to draw off the vaccine. The surface of this rubber top can be kept clean by wiping with a cotton-wool swab soaked in methylated spirit prior to each refill. By this procedure the vaccine is maintained free of extraneous contamination during the course of the operation.

After completing the number of sheep in the race, the syringe and needle are rinsed out with two charges of methylated spirit; in the meantime the next lot of ewes are being driven into the race.

FIG 1.—FILLING THE RACE PREPARATORY TO VACCINATION.

FIG. 2.—THE SITE OF INJECTION EXPOSED, SHOWING THE ANGLE OF THE SYRINGE WHEN INTRODUCING THE NEEDLE.

The vaccine in the container should be used up in one day so as to avoid any quantity being held over for use once the container has been opened. The vaccine in the unopened containers should be stored in a cool dark place until required for use.

Under the conditions outlined no untoward happening has followed vaccination, nor has any harmful result followed the handling of ewes in this manner comparatively close up to lambing.

Another method has been described in Australia, where vaccination has been done inside the thigh or alternatively inside the arm; either seems unnecessarily laborious, as the sheep have to be handled individually and held up in a sitting position on the rump—an undesirable procedure in the case of ewes advanced in pregnancy.

Conclusion.

The results of the trials carried out in the 1936 season lend further support to the possibility of reducing the mortality in lambs from pulpy kidney by vaccination of the pregnant ewe. The percentage loss in the vaccinated group in 1935 was 0·24 per cent., as against 0·306 per cent. in 1936.

The percentage loss in the control group in 1935 was 7·02 per cent., as against 3·36 per cent. in 1936.

There is a slight increase in the vaccinated group of only 0·066 per cent.; the variation in the response of different individuals to vaccination may possibly account for this. The losses in the control group are considerably down; this is in keeping with the general position in the district. Losses from pulpy kidney were rather widespread during the susceptible period, but the aggregate losses were as a rule appreciably below the average. This seasonal variation in incidence is a well-recorded factor.

In as many cases as possible the diagnosis in regard to the death of the lamb has been verified, but admittedly in the field a fractional margin of error has to be allowed in this respect, as it is obviously impossible to verify the cause of death in every instance.

It appears that the dose of the vaccine prepared by the Commonwealth Serum Laboratories could be increased with advantage at each vaccination.

Colostrum and blood samples have been taken from vaccinated and control ewes. Blood samples have been taken from lambs of each group at varying intervals. These were forwarded to Wallaceville Laboratory for immunization tests. The results of this work will be published at a later date.

Acknowledgments.

The vaccine used in the departmental experiments was prepared at the Veterinary Laboratory, Wallaceville, under Dr. Hopkirk. The vaccination work was largely done by A. L. Thompson, M.R.C.V.S., H. Doyle, M.R.C.V.S., and J. Danskin, M.R.C.V.S.

Field arrangements were made and observations kept by Messrs. J. Fleming, A. Douglas, and H. Rountree, Inspectors of Stock at Ranfurly, Lumsden, and Otautau.

Thanks are again due to those farmers in Otago and Southland who willingly co-operated with us.

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APPLICATION OF ORCHARD SPRAYS.

III. SPRAY NOZZLES—*continued.*

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DEPTH OF PENETRATION.

DEPTH of penetration refers to the distance to which spray is driven from the nozzles and serves to indicate the suitability of any nozzle for driving spray to the highest parts of trees and forcing it amongst the foliage, into bark crevices, bud-scales, &c.

In order to eliminate the influence of wind when making comparisons between different nozzles it was found necessary to take measurements under windless conditions, the maximum vertical height to which spray was driven being taken as an index of penetration. Thus measurements given in the following pages only indicate relative depths of penetration and cannot be taken as the actual distances to which spray would be driven under normal working-conditions.

EXPERIMENTAL METHOD.

A pole, marked in feet and 25 ft. in length, was erected in a perpendicular position. Close to the base of the pole the nozzles were fixed so that they pointed vertically upwards. Measurements of penetration were taken from the maximum height to which spray was actually driven, any drift in excess of this height being ignored. Owing to variations caused by slight air-movements, tests were repeated on two or three different days and the average measurements taken.

Nozzle-pressures were measured and adjusted, and the construction of different nozzle parts varied, by methods identical with those previously described for testing distribution and fineness of spray droplets (see this *Journal,* Vol. 53, p. 68).

RESULTS.

Pressure.—Increase in pressure from 50 lb. to 300 lb. caused a marked increase in depth of penetration (Fig. 18). The rate of increase was greatest as pressures were increased from 50 lb. to approximately 100 lb.

Increase in penetration with increasing pressure was highest where disks having the greatest diameter of apertures were used (Fig. 18).

Disk Aperture.—The depth of penetration increased as the diameters of the disk apertures were increased from $\frac{4}{64}$ in. to $\frac{6}{64}$ in. and $\frac{8}{64}$ in. The rate of increase with increasing diameter of disk aperture was highest where whorl-plates with the greatest diameter openings were used (Fig. 19).

Thickness of Disk.—Increase in disk-thickness from $\frac{2}{64}$ in. to $\frac{4}{64}$ in. caused a slight increase in penetration. Further increase in thickness to $\frac{6}{64}$ in. had no measurable effect.

Depth and Shape of Whorl-chamber.—Increasing the depth of the whorl-chamber from approximately 0·08 in. to 0·24 in. caused only a slight increase in penetration.

Alteration in the shape of the whorl-chamber by means of a $\frac{1}{4}$-in.-diameter pin projecting 0·04 in. from the centre of the whorl-plate did not cause any appreciable variation in penetration. With the pin projecting 0·08 in. penetration appeared to be slightly reduced.

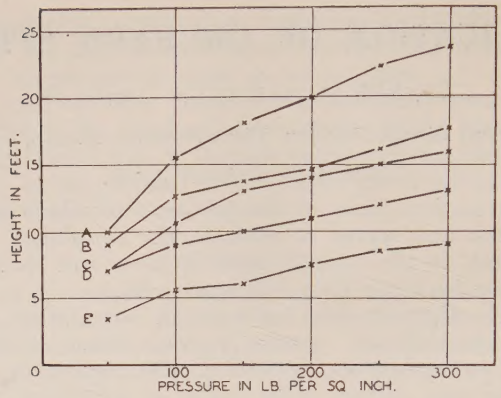


FIG. 18. EFFECT OF INCREASE IN PRESSURE ON THE MAXIMUM HEIGHT OF CARRY UNDER WINDLESS CONDITIONS.

The different curves show the effects produced when using whorl-plates and disks of varying construction, as follows :—

Curve A : Whorl-plate with six openings of diameter $\frac{12}{64}$ in. at angle of 22·5° ; disk aperture $\frac{8}{64}$ in. diameter.
Curve B : Whorl-plate with six openings of diameter $\frac{12}{64}$ in. at angle of 22·5° ; disk aperture $\frac{4}{64}$ in. diameter.
Curve C : Whorl-plate with six openings of diameter $\frac{4}{64}$ in. at angle of 22·5° ; disk aperture $\frac{8}{64}$ in. diameter.
Curve D : Whorl-plate with six openings of diameter $\frac{4}{64}$ in. at angle of 22·5° ; disk aperture $\frac{4}{64}$ in. diameter.
Curve E : Whorl-plate with two openings of diameter $\frac{4}{64}$ in. at angle of 67·5° ; disk aperture $\frac{8}{64}$ in. diameter.

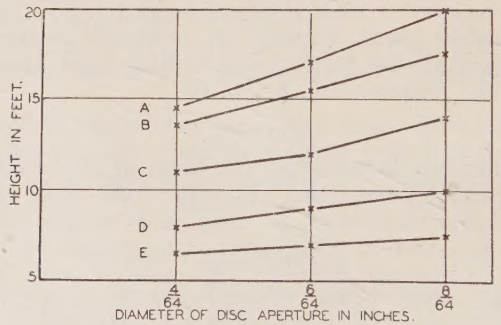
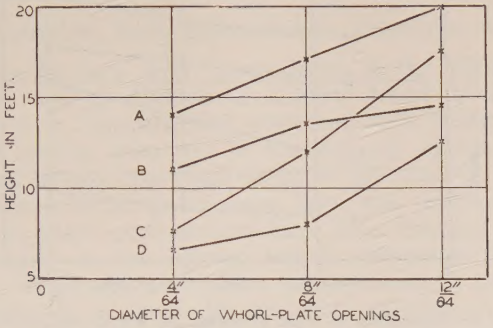


FIG. 19. EFFECT OF INCREASE IN THE DIAMETER OF DISK APERTURE ON THE MAXIMUM HEIGHT OF CARRY UNDER WINDLESS CONDITIONS WITH A NOZZLE PRESSURE OF APPROXIMATELY 200 LB.

The different curves show the effects produced when using whorl-plates of varying construction, as follows :—

Curve A : Whorl-plate with six openings of diameter $\frac{12}{64}$ in. at angle of 22·5°.
Curve B : Whorl-plate with six openings of diameter $\frac{8}{64}$ in. at angle of 22·5°.
Curve C : Whorl-plate with six openings of diameter $\frac{4}{64}$ in. at angle of 22·5°.
Curve D : Whorl-plate with two openings of diameter $\frac{8}{64}$ in. at angle of 67·5°.
Curve E : Whorl-plate with two openings of diameter $\frac{4}{64}$ in. at angle of 67·5°.

Diameter of Whorl-plate Openings.—Penetration was increased when the diameter of the whorl-plate openings was increased from $\frac{4}{64}$ in. to $\frac{8}{64}$ in. to $\frac{12}{64}$ in. This effect was most marked where disks having the greatest diameter apertures were used (Fig. 20).



G. 20. EFFECT OF INCREASE IN THE DIAMETER OF WHORL-PLATE OPENINGS ON THE MAXIMUM HEIGHT OF CARRY UNDER WINDLESS CONDITIONS WITH A NOZZLE PRESSURE OF APPROXIMATELY 200 LB.

The different curves show the effects produced when using whorl-plates and disks of varying construction, as follows :—

Curve A : Whorl-plate with six openings at angle of 22·5° ; disk aperture $\frac{8}{64}$ in. diameter.

Curve B : Whorl-plate with six openings at angle of 22·5° ; disk aperture $\frac{4}{64}$ in. diameter.

Curve C : Whorl-plate with two openings at angle of 67·5° ; disk aperture $\frac{8}{64}$ in. diameter.

Curve D : Whorl-plate with two openings at angle of 67·5° ; disk aperture $\frac{4}{64}$ in. diameter.

Angle of Whorl-plate Openings.—Increase in the angle of the whorl-plate openings from 22·5° to 45° and 67·5° decreased penetration in those cases where whorl-plates with apertures $\frac{4}{64}$ in. and $\frac{8}{64}$ in. diameter were used. With whorl-plate apertures of $\frac{12}{64}$ in. diameter the effect of increase in the angle of the openings on the depth of penetration was not significant (Fig. 21).

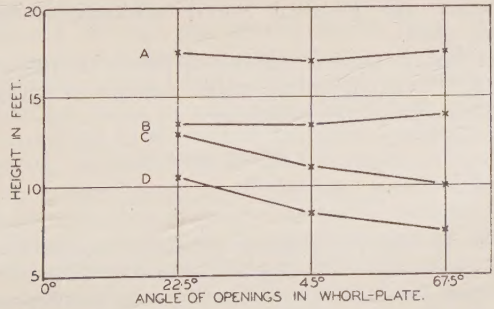


FIG. 21. EFFECT OF INCREASE IN THE ANGLE OF WHORL-PLATE OPENINGS ON THE MAXIMUM HEIGHT OF CARRY UNDER WINDLESS CONDITIONS WITH A NOZZLE PRESSURE OF APPROXIMATELY 200 LB.

The different curves show the effects produced when using whorl-plates and disks of varying construction, as follows :—

Curve A : Whorl-plate with two openings of diameter $\frac{12}{64}$ in. ; disk aperture $\frac{8}{64}$ in. diameter.

Curve B : Whorl-plate with four openings of diameter $\frac{12}{64}$ in. ; disk aperture $\frac{4}{64}$ in. diameter.

Curve C : Whorl-plate with two openings of diameter $\frac{8}{64}$ in. ; disk aperture $\frac{8}{64}$ in. diameter.

Curve D : Whorl-plate with two openings of diameter $\frac{4}{64}$ in. ; disk aperture $\frac{8}{64}$ in. diameter.

Number of Whorl-plate Openings.—The depth of penetration was increased by increase in the number of whorl-plate openings from two to four and six (Fig. 22).

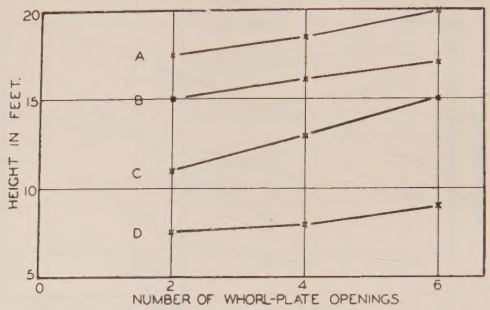


FIG. 22. EFFECT OF INCREASE IN THE NUMBER OF WHORL-PLATE OPENINGS ON THE MAXIMUM HEIGHT OF CARRY UNDER WINDLESS CONDITIONS WITH A NOZZLE PRESSURE OF APPROXIMATELY 200 LB.

The different curves show the effects produced when using whorl-plates and disks of varying construction, as follows:—

Curve A: Whorl-plate with diameter of openings $\frac{12}{64}$ in. at angle of 22·5°; disk aperture $\frac{8}{64}$ in. diameter.

Curve B: Whorl-plate with diameter of openings $\frac{12}{64}$ in. at angle of 45°; disk aperture $\frac{6}{64}$ in. diameter.

Curve C: Whorl-plate with diameter of openings $\frac{8}{64}$ in. at angle of 45°; disk aperture $\frac{8}{64}$ in. diameter.

Curve D: Whorl-plate with diameter of openings $\frac{4}{64}$ in. at angle of 45°; disk aperture $\frac{4}{64}$ in. diameter.

Strainer.—The use of a strainer had no measurable effect on the depth of penetration.

GENERAL OBSERVATIONS.

The maximum height of carry was varied considerably by wind, being reduced 50 per cent. by even a light breeze. It was noted that the effect of wind was greatest where nozzles having the poorest penetration were used.

Some of the spray tended to fall before reaching the maximum height, thus only a portion of the total volume of spray delivered by the nozzle had maximum penetration.

(To be continued.)

The production of superphosphates in 1935–36 reached a new record high level (322,522 tons), being 5,542 tons, or 2 per cent., greater than the 1934–35 figure.

Pedigree Grass and Clover Seeds.—With a view to further improving the pastures of the Dominion, the Division early in 1935–36 had harvested some Government pedigree grass and clover seeds. Such seed, which will be produced during each succeeding year, has been grown on contract from seed especially raised at the Plant Research Station at Palmerston North. The production of such seed is considered to mark a further advance in the already high standard of the Dominion's certified seed. Pedigree stock seed is intended for sowing down areas to be devoted to the production of certified pedigree seed. No difficulty whatever was experienced in the disposal at remunerative prices of the 800 bushels of Government pedigree stock perennial rye-grass seed and several hundred pounds of pedigree white-clover seed.—*Annual Report, Director of the Fields Division.*

FARMERS' FIELD COMPETITIONS.

WELLINGTON DISTRICT, SEASON 1935–36.

C. J. HAMBLYN, Fields Superintendent, Palmerston North.

A REVIEW of the farmers' field competitions in the Wellington district for the season 1935–36 discloses a definite trend in the direction of increased interest in competitions connected with pastures. A rise in the number of entries from 912 in the 1934–35 season to a total of 1,318 in the past season is accounted for in the main by a considerable increase in the entries for grass-silage, hay, and pasture competitions. In those districts where competitions have been recently started, fodder crops figure largely in the entries, but as experience in competition work is gained, silage and hay take a more prominent part, and finally pasture competitions, undoubtedly the most valuable of all, are taken up.

The cheapest food produced on the farm comes from the pastures, and it is safe to say that 95 per cent. of the feed produced on the average North Island farm is derived from grass. Further, the quality and value of the grass, hay, and silage depends largely on the quality of the raw material—that is, the pastures. Therefore, competitions designed to assist in improving the pastures of a district tend to increase the quantity and value of the main source of feed, and automatically improve the quality of hay and silage reserves. While North Taranaki is, as yet, the only district where progress has been made in pasture competitions, the success of these competitions, which is due in a large measure to the satisfactory method of judging evolved, has aroused interest in other districts, and a satisfactory extension of these competitions is indicated. There is little doubt that this type of competition will gradually supersede the original fodder-crop competitions.

Another factor which should favour this trend is that, while in districts new to competitions the general average yield of fodder crops is rapidly increased through the lessons learnt from the competitions, there comes a time when further improvement in economical crop production is likely to be gained more effectively by means of experimental and demonstrational work in connection with new varieties of higher feeding-value, economy in the use of artificial fertilizers, &c. A review of varieties grown, fertilizers used, and methods of cultivation in the case of root-crop competitions reveal the fact that, while there has been undoubtedly some selection of proved suitable varieties and more attention paid to cultural methods, there have been few, if any, new varieties tried. There is still a wide divergence in the type and amount of artificial manures used, and no uniformity has been arrived at in regard to spacing either in the rows or between the rows for the various crops.

The organization of the field competitions in North and South Taranaki, Wanganui, Manawatu, Wairarapa, and Hawke's Bay districts has been carried out by the various branches of the Farmers' Union, while in the Poverty Bay district the directorates of the dairy companies have played a prominent part with valuable assistance from the A. and P. Societies. In most districts local competitions are arranged by individual branches of the Farmers' Union, and in many cases several branches have combined in group competitions.

In North Taranaki, in addition to the group or district competitions, a central executive arranges for North Taranaki championships in all classes, and the championship judging in some of the competitions is made the occasion of combined field-days attended by large gatherings of farmers from a widespread area. The same procedure is being developed in South Taranaki, and should extend the interest and value of the competitions.

The following table illustrates the present position with regard to the extent and scope of the competitions in the Wellington District :—

Competition.	North Taranaki.	South Taranaki.	Wanganui.	Manawatu.	Wairarapa.	Hawke's Bay.	Poverty Bay.	Total.
Mangels	15	10	10	34	11	10	28	118
Carrots	39	13	12	6	..	4	..	74
Swedes	53	12	..	16	..	12	..	93
Chou moellier ..	..	5	..	11	12	9	..	37
Mixed roots ..	17	..	..	..	..	..	..	17
Hay	184	59	..	..	..	..	..	243
Silage	281	64	..	17	..	24	42	428
Pasture	308	..	..	..	..	..	..	308
	897	163	22	84	23	59	70	1,318

Compared with the 1934–35 season, while there has been a slight drop in the entries for root crops, from 343 to 339, there has been an increase in entries for hay, from 170 to 243, a greater increase in ensilage, from 274 to 428, and a considerable extension of the North Taranaki pasture competitions, from 107 to 308 entries.

The judging of the competitions was again carried out by the Instructors of the Fields Division of the Department of Agriculture, and certificates of merit were awarded to leading competitors. In most districts interest in the judging was well maintained, and the round of the entries was made by large numbers of farmers, and the occasion made a field-day, when useful discussions on methods and results take place. In a few districts this important feature of competition work has unfortunately not been developed, or has lapsed, and much of the value of the competitions is lost. Another important part of the competitions is the valuable report and criticism prepared by the judges on each competition for local publication and discussion at prize-giving functions.

Mangels.

The wet summer was not favourable to this crop. Many farmers were unable to keep weeds in check, but even where crops were perfectly clean the yield was considerably lower than in the previous dry season. The heaviest crop in the Wellington District, of 115 tons, was grown by Mr. N. Hughes, of Maxwell. In a special Young Farmers' Club competition in the Gisborne District, there were seventeen entries, the average yield of the crops was 80 tons per acre, and the heaviest crop, of 131 tons, was grown by Mr. R. H. Nelson.

Carrots.

Carrots were not so much affected by the adverse weather, though the average yield was 7 tons per acre less than for last year. Of

seventy-four entries, with an average yield of 43 tons, the best crops were grown by Mr. H. A. Shaw, Eltham, 71 tons 8 cwt. (a splendid crop of Matchless White), and Mr. N. Hughes, Maxwell, 64 tons 13 cwt. of Matchless White and 59 tons 12 cwt. of Guerande. The Guerande was again prominent in regard to number of entries and average yield, while Holmes's Improved was favourably commented on in North Taranaki and Matchless White in the southern portion of the same province.

Swedes.

In contrast to the lower average yields from mangels and carrots, swede crops were generally good. Ninety-three crops were judged in the various competitions, the best crops being grown by Mr. C. Spence, Apiti, Manawatu, 64 tons per acre, and Mr. A. Mullinder, Otawhao, Hawke's Bay, 61 tons 11 cwt. Superlative was again the favourite variety, but two later-maturing varieties, Vilmorin and Wilhelmsburger, gave satisfactory yields, and were particularly free from dry-rot. For this reason these varieties should prove valuable to growers requiring swedes for late-winter and early-spring use. Both varieties develop very strong roots, and are not easy to pull.

Chou Moellier.

The number of chou moellier crops judged increased from twelve to thirty-seven, and yields were considerably better than in the previous year, the wet conditions favouring this crop. It appears that the growing of chou moellier is on the increase, mainly because of its resistance to club-root. Dry-rot was prevalent in some crops, particularly where chou moellier followed a previous crop of swedes or soft turnips. Competitions were again held in South Taranaki and Hawke's Bay, and new competitions for this crop were conducted in the Wairarapa and Manawatu. The best crops were grown by Mr. A. S. D'Ath, Feilding, 44 tons; Mr. T. H. Verry, Konini, Pahiatua, 43 tons 16 cwt.; and Mr. W. G. Hunt, Otawhao, Hawke's Bay, 42 tons 12 cwt. The best crop the previous season was one of 29 tons.

Ensilage.

There was a marked increase in the number of entries judged in the ensilage competitions, from 274 to 428, although in several districts many ensilage stacks and trenches entered were not opened up for judging on account of plentiful winter feed-supplies. In North Taranaki the competition was again divided into five classes, a total of 281 entries being judged, the championship awards being as follows: Stack ensilage-grass (154 entries), R. G. Luxton, Urenui; stack silage, any other crop (nine entries), H. T. Paul, Okato (oats); hillside stack silage (twenty-five entries), W. Summers, Tariki; earth pit silage (thirty-one entries), J. H. Paulger, Tikorangi; concrete pit silage (twenty entries), E. C. Locke, Hillsborough.

In South Taranaki there were sixty-four entries comprised of stacks, fifty; earth pits, twelve; and concrete pits, two. The winners of the two main classes were—Stack ensilage (grass), Mr. G. Hurley, Whenuakura; pit silage-grass, Mr. F. J. Mehrtens, Eltham. Entries in the Poverty Bay district increased from fourteen to forty-two; the Gisborne - East Coast district competition was won by a Maori farmer, Mr. J. B. Dews, Ruatoria; and the Wairoa competition by Mr. H. S. Findsen.

In Southern Hawke's Bay twenty-four entries from the Takapau and Norsewood districts were judged, the winner being Mr. W. Jenkins, Norsewood.

The Wairarapa ensilage competition was abandoned, as a large proportion of the entries were not being opened up.

In general, while the stack method is still favoured in Taranaki, the trench or pit method, because of the reduction in labour and equipment necessary, is being developed in most other districts, and particularly in Hawke's Bay and Poverty Bay. One of the first results of ensilage competitions is a marked and rapid improvement in the type and uniformity of the silage made. Another good result is the elimination of waste through better stacking and covering. These improvements can be and are made in too many cases without a proportionate improvement in the quality of the silage or in the value of the material for the main purpose for which it is made—that is, milk-production.

Grass silage is used rather indiscriminately for two distinct purposes—first, for milk-production occasionally in dry summers, but mainly in the early spring when grass-supplies are short, and secondly for winter-feeding of dry stock. For milk-production the value of the silage, judged under the heading of quality, would depend on the stage of cutting—that is, the content of fibre—and also on the composition in respect to good grasses and clovers. For winter-feeding of dry cows and young stock a considerably more fibrous and bulky type of silage would appear to be more suited to the requirements of the stock. It seems desirable, therefore, in competitions to define the use to which the silage is to be put and to divide the competitions if necessary into two classes, one for milk-producing silage and another for winter feed. Such a division would probably require judging of the latter in June or July and the former in August or early September. In the case of milk-producing silage, greater attention could then be paid in judging to the stage of cutting, since it is well known that pasture coming into flower is too rank for good milk-production.

Hay.

Haymaking competitions were again confined to the Taranaki Province, where 243 entries were judged, as compared with 170 the previous year. Early-cut crops escaped the broken weather which spoilt the majority of the later crops, and the winners of the various district competitions were amongst those that experienced favourable haymaking conditions. The North Taranaki winners were—for grass hay, J. M. Blyde, Lepperton; oaten hay, E. B. Corbett, Okato. For South Taranaki—grass hay, O. T. Parry, Manaia; and for lucerne hay, T. R. Taylor, Manutahi.

Pasture Competitions.

The North Taranaki pasture competitions were considerably extended, a total of 308 pastures being judged, as compared with 107 the previous year. Details of this competition have been published in this *Journal*. As previously mentioned, this type of competition is being arranged for in the South Taranaki, Hawke's Bay, Poverty Bay, and Manawatu

districts, and should do much to assist in improved pasture establishment and management, and incidentally improve the quality of raw material in the use of grass-ensilage and meadow-hay competitions.

Conclusion.

Great credit is due to the officers of the numerous branches of the Farmers' Union for the active part taken in the organization of the competitions, and also to those dairy companies and agricultural and pastoral associations which have interested themselves in various district competitions. The continued interest in the competitions, as indicated by increasing entries and wider scope of the work, is encouraging to both the organizers and judges.

WINTON EXPERIMENTAL AND DEMONSTRATION FARM.

RECORD OF WORK FOR SEASON 1935–36.

A. Stuart, Instructor in Agriculture, Invercargill.

The 1935–36 season was again rather unfavourable for dairying operations, as was exemplified by a slight decrease in production, due to a late spring being followed by dry conditions in the summer months, although this was compensated for to some extent by the grass-growth experienced in the autumn and early winter. This season 5,499 lb. of butterfat were actually sold from the thirty-three cows milked, compared with the 6,959 lb. from thirty-six cows the previous season. Ten calves were reared, and the whole herd was recently tested for tuberculosis, with a negative result from the reaction standpoint.

The ewe flock, consisting of eighty-five ewes, produced 110 lambs, and of these 100 lambs were obtained fat off their mothers. The flock was grazed from lambing till weaning on a paddock of less than 12 acres, and which had been sown in 1931 with certified rye-grass as the basis of the seeds mixture.

In April it was found that the Aberdeen turnips, which had been sown as a second crop following swedes, were unsafe to feed to the dairy herd owing to a severe wet-rot infection following dry-rot. Ninety wethers were purchased to clean up this area, and these were later disposed of when fat at a profit.

Carrying-capacity Trial.

This trial was laid down in the spring of 1933 in field 6 to determine the relative carrying-capacity and production of certified and uncertified rye-grass. One-half of the area was sown with certified rye-grass and the other half with a blend of five uncertified commercial lines of rye-grass. An uncertified white-clover strain was included in both, which were sown with oats as a nurse crop.

During the first autumn the uncertified rye-grass gave the best results, carrying slightly more stock and producing more butterfat,

but since that period the certified rye-grass has steadily forged ahead. The table appended below gives the carrying for this season together with the butterfat produced per acre.

Month.	Certified Rye-grass.		Uncertified Rye-grass.	
	Cow-days per Acre.	Butterfat (Pounds) per Acre.	Cow-days per Acre.	Butterfat (Pounds) per Acre.
September	30·3	17·0	10·0	5·4
October	45·3	27·2	27·9	17·9
November	21·2	13·2	19·3	21·9
December	86·7	91·5	69·3	75·5
January	44·8	37·8	31·2	24·3
February	30·1	20·8	13·2	9·7
March	25·6	16·4	25·6	16·8
April	38·7	22·3	21·6	10·6
May	36·0	18·9	14·4	6·5
June	25·2	4·7	7·2	0·9
July and August ..	Nil	Nil	Nil	Nil
Totals for year ..	383·9	269·8	239·7	189·5
Totals to date since first grazed	722·5	584·6	512·2	442·6

In addition, 21·1 dry-stock-days per acre have been obtained from the certified rye-grass, and 13·6 dry-stock-days per acre from the uncertified rye-grass.

The areas seen at the present time present a more striking difference than is exemplified in the figures given above. The sward of the certified area is a dense mat of vigorous rye-grass and white clover, whereas the sward of the uncertified is very open, consisting mainly of white clover with some rye-grass, and an invasion of brown-top, Yorkshire fog, and Scotch thistle has taken place.

Root-crop Investigations.

Contrary to the experience obtained in the two last seasons, it was found possible to grow, no doubt due to weather conditions, quite fair swedes as a second crop in field 5. Seventy-two varieties were hand-sown on land preridged and fertilized with 2 cwt. per acre of superphosphate applied through the front box plus 2 cwt. of equal parts of superphosphate and carbonate of lime through the rear box. These swedes were examined for club-root and mottled heart, and whereas the percentage of club-root varied from nil to 73·5, mottled heart was 100 per cent. prevalent in thirty-two varieties.

In this field two blocks of Aberdeen turnips were grown, one block consisting of certified Bruce turnip, and the other, seed of Victor Achilles. Both these crops, and in particular the latter, suffered from the ravages of dry-rot, which early in April turned to a wet-rot, and prevented the area being fed to the dairy herd, although before this was known four cows succumbed to bloat after half-an-hour's grazing on the field. Victor Achilles yielded 33 tons per acre, and the Bruce 27 tons per acre. Mottled heart was detected in both crops.

In field 8, which was ploughed out of lea early in the winter, five blocks of swedes were grown with the same manurial treatment as quoted above, except that in addition half of each block received a

pre-top-dressing of 10 cwt. per acre of carbonate of lime some time before sowing. The five varieties were examined for mottled heart and yielded as follows—the weights on limed and unlimed ground being averaged :—

Variety.	Yield in Tons per Acre.	Percentage of Mottled Heart.
Grandmaster	62·23	95
Ninety-nine	62·15	100
Tipperary	52·92	100
Wilhelmsburger Otofte ..	51·02	90
Peerless	49·40	100

In addition, small-variety trials were conducted in both the above fields in connection with certified seed. Kohl rabi was also tried and found to be subject to club-root, and in no degree comparable to chou moellier or kale.

Grass and Clover Trials.

The duplicate series of plots laid down in November, 1934, at either end of field 9 were fenced, and subjected to differing forms of management in that, while one was grazed intermittently throughout the year, the other was hayed and the aftermath grazed. The haying and more lenient management has resulted in great stimulation to the Montgomery red clover which was employed in the basic seed mixture, and no doubt further differences will appear after a further period. In both series very little false perennial rye-grass remained in these particular plots after eighteen months. Meadow fescue, where substituted for perennial rye-grass, also failed to withstand competition. All these plots have become clover dominant.

In field 7 the original two hundred rye-grass plots which were established seven years ago still present the marked differences in the density of the rye-grass in the sward, the poorer plots having filled in with brown-top and *Poa annua*.

In field 2 the rye-grass germination trial consisting of 330 lines was harvested early in January, but, unfortunately, owing to the fairly low rainfall conditions experienced in December, no fungus attack developed on the seed, which was all of good germination. This experiment will be repeated this season, and by the law of averages some results should be forthcoming, as the district has already experienced two successive dry seasons with consequent good germination of certified rye-grass seed.

Miscellaneous.

An oat-treatment trial to determine the relative merits of dry-dusting seed with "Ceresan New" or pickling with formalin was carried out during the season in field 2. Results of this trial have already been published in the *Journal of Agriculture*, Vol. 53, August, 1936.

An oat-variety trial was also laid down in field 1, but owing to the loose texture of the soil, coupled with early spring sowing, birds totally destroyed the experiment at an early stage.

The rate-of-liming trial laid down in August, 1933, on grass showed up remarkably during the autumn. The incidence of grass-grub and

Porina attack was most marked on the unlimed ground, steadily decreasing in the 1- and 2-ton-per-acre blocks, and being practically unnoticed on the 4-ton-per-acre block, where both grasses and clovers were the most vigorous and dense.

ACKNOWLEDGMENTS.

The capable manner in which the work on the farm has been performed by the farm-manager, Mr. P. McMillan, warrants favourable mention, and as a result the farm committee under the able chairmanship of Mr. D. H. McLean, Caroline, has been relieved of undue anxiety. Material assistance was again forthcoming from the R. M. McKinnon Trust, in addition to the Government subsidy, and this assistance is greatly appreciated.

In connection with the comprehensive trial to measure the differences in carrying-capacity and production between certified rye-grass and the best local strains employing a ewe flock, and for which arrangements have already been made, the following farmers have donated seed, which is gratefully acknowledged: W. Allison, Drummond; E. S. Beck, Wairio; J. H. Beck, Woodlaw; E. A. Cameron, Freshford; S. Irwin, Browns; R. Kennedy, Bayswater; D. McDonald, Dipton; J. C. Paterson, Wendonside; J. Plunkett, South Hillend; Spratt Bros., Drummond; T. S. Smith, Winton; and M. S. Thomson, Lochiel.

STRAIN IN SUBTERRANEAN CLOVER.

E. BRUCE LEVY and L. W. GORMAN, Grasslands Division, Plant Research Bureau.

SUBTERRANEAN clover (*Trifolium subterraneum*) is an annual which perpetuates itself by copious reseeding. In grassland economy the annual is important, and more particularly so under soil and climatic types that impose on the vegetation periodic and seasonal stresses unfavourable to sustained growth. Low soil-fertility that permits of vacant spaces in the sward, or drought that causes growth to cease and swards to open, are the two major contributing factors to the income and persistence of the annual. The common annual clovers in New Zealand grasslands may be arranged in an ecological order ranging from the hardest and poorest of habitats up to habitats where the perennial species are able to dominate. Haresfoot trefoil, striated clover, clustered clover, suckling clover, hop-trefoil, reversed clover, subterranean clover, spotted burr-clover, and toothed burr-clover represents a fairly accurate placing in ascending order according to habitat, the haresfoot trefoil occupying the poorest and hardest habitat and the burr-clover the more fertile. The habitat a stage better than the burr-clover habitat may be occupied by perennial species, and the chief of these is white clover. White clover, however, also perpetuates itself on fairly hard habitats by reseeding, and in this regard it is of great ecological interest that the poorer, short-lived, almost annual strains of white clover dominate on the more arable and harder habitats in New Zealand, the more perennial strains occupying the really high-fertility habitats that seldom are

subject to hard seasonal conditions. Of the perennial strains of white clover, Kentish wild white appears to offer the best form for perennial low-fertility habitats, the New Zealand type 2 the more suitable for the next grade of soil, and the New Zealand type 1 for the most fertile soils or those that can be rendered so by top-dressing, &c.

This classification of clover types enables one to visualize readily the place subterranean clover may take in grassland ecology. The burr-clovers may be ruled out as being unsuitable for pasture work on account of their low palatability and burr-like seed-pods that are a menace to the wool crop. Thus subterranean clover occupies a place in grassland ecology intermediate between suckling clover and perennial strains of white clover, merging well with the suckling clover habitats and covering as well the habitat range of the annual and short-lived strain of white clover. A plant in such a position is of great value in any programme of pasture improvement where the initial soil conditions are such that good strains of white clover may not be readily established. Subterranean clover, then, is a pioneer acting in the capacity of a stepping-stone between the less valuable annual clovers and white clover. The above arrangement of clovers is a reliable index of the available soil fertility, particularly in regard to available supplies of phosphate, potash, and lime, and just as each represents a fertility standard so each represents a fertility demand. Thus subterranean clover has a soil-fertility demand between suckling and white clover.

The rise of a species to dominance in grassland is a reflex of its ability to produce under the conditions offering. Thus, in a rising scale of fertility upbuilding, subterranean clover replaces suckling clover and white clover replaces subterranean clover, provided always in the latter case that droughts do not hinder and retard the development of the perennial white clover.

The ability of subterranean clover to produce more fodder than suckling clover is the keynote to the successful use of phosphatic top-dressing on country that prior to the introduction of subterranean clover scarcely returns sufficient growth to warrant the expense of top-dressing. Haresfoot trefoil, striated clover, clustered clover, and suckling clover all respond to phosphatic top-dressing, but the results from top-dressing these plants have not encouraged the widespread use of phosphate on them. The introduction of subterranean clover on to country carrying swards where the lesser annual clover dominated previously has meant an extended range of country that can be profitably top-dressed, and this fact has led to an enormous increase in the amount of subterranean-clover seed sown during the last two or three years. It must be realized that the value of subterranean clover is largely wrapped up in the knowledge that the country pays to top-dress when subterranean clover is present, and does not pay to top-dress when subterranean clover is absent.

This point alone is of great significance, because the moment phosphate may be economically applied any grassland farmer has the making of his country in his own hands. Phosphate is the driving force to grassland progress, and the more efficiently this

FIG. 1. PERENNIAL RYE-GRASS, SUBTERRANEAN CLOVER, WHITE CLOVER IN ASSOCIATION ON RIVER-ACCRETION COUNTRY, GIVING A GOOD SWARD WITH THE SUBTERRANEAN CLOVER DOMINATING THE WHITE CLOVER.

Such a sward can be profitably top-dressed.

[*Photo by E. Bruce Levy.*

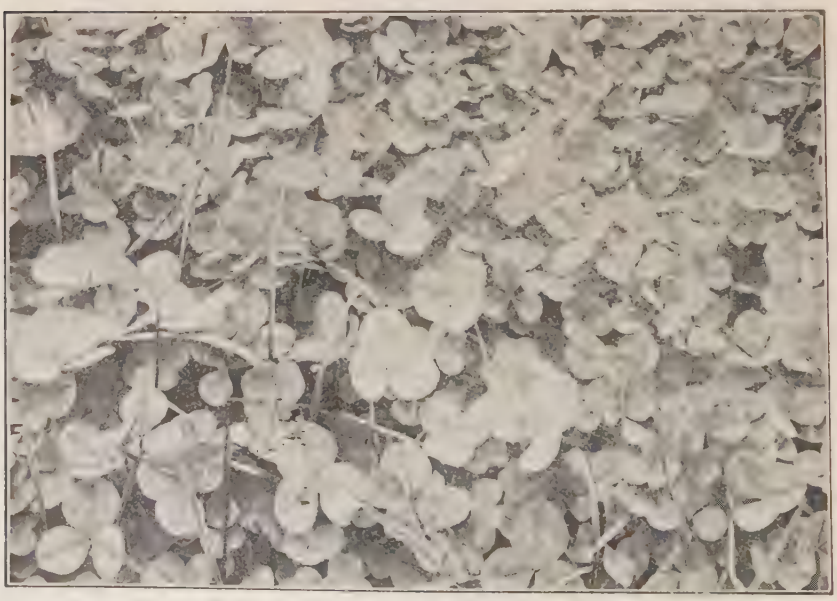


FIG. 2. PERENNIAL RYE-GRASS, WHITE CLOVER, SUBTERRANEAN CLOVER IN ASSOCIATION ON RIVER-ACCRETION COUNTRY.

White clover is dominating the subterranean clover wherever the soil fertility is sufficiently high for good white-clover growth or is being maintained at a high level by the use of superphosphate.

[*Photo by E. Bruce Levy.*

force can be applied the greater the progress. Subterranean clover is a more efficient and larger-capacity machine for the exploitation of phosphate than are the lesser annual clovers, and on this fact lies its intrinsic potential value on all those soil types which in their initial unimproved conditions do not, or cannot be economically made to, support white clover.

The writers in subsequent pages have dealt with the question of strain in subterranean clover, and it will be clear that there are possibilities in regard to the use of various strains. Subterranean clover in itself reflects extremely well the selective propensities of a species to variously conditioned habitats. Thus we have the extremely early, stemmy, free-seeding, short-lived strains that are suitable for the extremely dry habitats where only short periods for growth intervene between periods of drought. The mid-season strains can be regarded as suitable for less droughty conditions, and the late strains suitable for areas where moist conditions prevail well into the season. Ecologically there is no call in New Zealand for the specially early-flowering group, but there is definitely a place for the mid-season- and late-flowering groups. Both these latter groups are desirable—the mid-season to give the autumn, winter, and early spring growth, and the late to continue the spring growth further into the summer. Thus the use of the two strains, either blended together in the one mixture or sown as separate paddocks, tends to extend the seasonal range of production of subterranean clover on the farm.

Subterranean clover generally should not be sown pure, but for preference should be combined with a good perennial strain of white clover and perennial rye-grass.

The reason for this is obvious, viewing the possibilities for improvement and development that are created by phosphating and by increasing the stock carried per acre as a result of the increased feed produced. The subterranean clover initiates the improvement, and the stock carried, in addition to the phosphate applied, carries this improvement forward to a point where the conditions are made suitable for the growth of good strains of white clover and rye-grass, and the moment this eventuates, provided the white clover and the rye-grass are included, the development is carried a stage further, to the point that there develops a rye-grass-white-clover sward with the subterranean clover occupying a smaller and smaller position in the grassland, it going the way of all annuals once the soil conditions are brought to a stage where the high-producing perennial species are adequately provided for.

In the case of developing very low-fertility soils which have to undergo marked change before the rye-grass-white-clover sward is possible, then pure sowings of subterranean clover may be fully justified, but where the soil and climatic conditions are not far removed from the possible rye-grass-white-clover sward, then the three species should be combined.

Strain Trials.

Altogether fifty-seven different samples of this seed have been grown at this station. Nine were from commercial sources and forty-eight

were obtained from Australian research stations. After making general observations for a period of three years, a more intensive study was commenced. This has been in progress for the last two years. Seed of each sample was sown in boxes of sterilized soil on 11th February, 1935. The resulting seedlings were planted out in May as spaced plants 1 ft. apart in plots 10 ft. long by 5 ft. wide, and then allowed to grow and join up to form the equivalent of a broadcast plot. Completed records on these plots over a period of one year were kept, and the following matters were recorded: Nature of growth (leafy or stemmy); time of commencing growth (late winter or early spring); date of com-

FIG. 3. SUBTERRANEAN-CLOVER STRAIN TRIALS SHOWING SPRING GROWTH AND PARTICULARLY THE GOOD EARLY SPRING GROWTH OF THE BURNERANG AND NANGEELA STRAINS.

Photograph taken 16th October, 1935.

Foreground (left to right): (*a*) Burnerang. (*b*) Nangeela.
Second row: (*a*) Mount Barker. (*b*) Mount Barker. (*c*) Tallarook.
Third row: (*a*) Myall. (*b*) Daliak. (*c*) Wenigup.
Fourth row: (*a*) Mount Barker. (*b*) Tallarook. (*c*) Dwalganup.

[*Photo by L. W. Gorman.*

mencing flowering; date of dying off (summer); yield of herbage; time of re-establishment from shed seed; autumn growth; rust infection; winter growth. When all these matters were taken into consideration it was found that the samples could be classified in four groups. The general characteristics of these groups are as follows:—

Group 1.—Each strain included in this group has small dark-green-coloured, indistinctly marked leaves. The plants were stemmy and prostrate in habit. In the year of planting the time of commencing growth was delayed till the beginning of August, and even then the growth consisted of only a few short trailing stems bearing a number of

florets but very few leaves. Flowering commenced very early (the first week in August). Subsequent growth was limited in amount, and these plants were the first to die off in the summer (last week in December). The total production for this growing-season was extremely low. (See Tables 1 and 3.) As the result of heavy summer rains re-establishment from shed seed was very early (third week in January). For the next three months growth was rapid and production good. After cutting (early in May), these strains, together with all others, remained dormant till mid-July. Leaf-growth then

FIG. 4. SUBTERRANEAN-CLOVER TRIALS SHOWING THE TOTAL AMOUNT OF GROWTH UP TILL THE END OF SPRING.

Photograph taken 28th November, 1935.

Foreground (left to right) : (*a*) Myall. (*b*) Daliak. (*c*) Wenigup.
Second row : (*a*) Mount Barker. (*b*) Tallarook. (*c*) Dwalganup.
Third row : (*a*) Dwalganup. (*b*) Hill's Small-seeded. (*c*) Wangaratta.

[*Photo by L. W. Gorman.*

commenced, and production has been quite good, but early maturity is indicated by the fact that flowering has been general during the last week in July of this year.

Group 2.—The strains of this group are leafy and have a leaf-size greater than those of Group 1. In the year of planting growth was early and good right from the beginning of August till the end of December. The total yield of green herbage was very high. (See Tables 1 and 3.) The commencement of flowering varied between 13th September and 18th October. Good seed-setting followed. Re-establishment of seedling plants commenced before the end of January, and rapid growth followed. This group gave the highest production for the autumn period (see Tables 2 and 3), and has been able to make a moderate amount of growth in midwinter.

Group 3.—This group closely resembles Group 2 in that habit of growth, time of flowering, and seasons of production are as given above. The essential differences which define this group are—(1) Growth is very limited till after the beginning of September (one month later than that for Group 2); (2) total production is of good average only, being at all times considerably below that of Group 2. Autumn establishment and growth was good, but from the beginning of May till the end of July this group has been completely dormant.

Group 4.—When in full growth these strains are large-leaved, but throughout the early part of the spring they appear as small leafy rosettes, and productive growth does not start till as late as the last

FIG. 5. SUBTERRANEAN-CLOVER TRIALS SHOWING THE TOTAL AMOUNT OF HERBAGE PRODUCED FROM THE LATE WINTER TILL THE END OF SPRING ON THE SAME PLOTS AS SHOWN IN FIG. 4.

These were cut and weighed on 29th November, 1935.

[*Photo by L. W. Gorman.*

week in September. From that time onwards growth is very rapid and within the following eight weeks there is a greater yield of green material than is made by strains of any other group even when these others commence growth eight to ten weeks earlier. Flowering did not occur till after the middle of October, and these late strains continued to make good growth till the end of December, and actual death did not occur till mid-January (two weeks later than for other groups). This late dying-off was followed by delayed germination, and re-establishment was six weeks later than for Groups 1 to 3. Fairly good autumn growth followed till the beginning of May, after which growth remained dormant for a period of two months. Towards the end of July the plants of these strains appeared as small leafy rosettes, giving good ground cover but not making any productive growth.

Tabulation of Data regarding Seasonal Production.

Some indication of the relative production of each group can be ascertained by reference to Tables 1 and 2, which have been compiled from relative values (0–10) allotted to each strain at fortnightly intervals throughout the growing-period, which extended from mid-July of the one year to the beginning of May of the following year. In these tables each group is compared with Group 3 = 100, since this group has given a fairly average performance at all periods of growth.

Table 1.—Production of each Group of Subterranean-clover Strains relative to Group 3 = 100 for the Period Mid-July to the End of December.

	Number of Lines.	Mid-July to End of December.			
		Mid-July to 31st August.	1st September to 30th September.	1st October to 29th November.	29th November to 23rd December.
Group 1	4	5·6	14·6	4·5	Nil
Group 2	5	131·0	145·7	133·6	30·8
Group 3	17	100·0	100·0	100·0	100·0
Group 4	7	100·0	86·7	102·9	272·0

This table shows the superiority of Group 2 right from late winter and throughout the spring. The low production and early death of Group 1 is emphasized, as is also the late-spring and early-summer growth of Group 4.

Table 2 shows the relative growth from the end of January till the end of July.

Table 2.—Production of each Group of Subterranean-clover Strains relative to Group 3 = 100 for the Period Late January till the End of July (i.e., *after Re-establishment from Shed Seed).*

	Number of Lines.	Late January to End of July.		
		23rd January to 2nd March.	2nd March to 4th May.	27th May to 30th July.
Group 1	4	38	123	633
Group 2	5	108	124	296
Group 3	17	100	100	100
Group 4	6	7	69	80

Here again Group 2 is consistently above the average. The relatively good autumn and winter growth of Group 1 is indicated, but although for June and July Group 1 appears twice as productive as Group 2 the total production even for Group 1 is quite low. The figures for Group 4 emphasize its late establishment, which is followed by relatively lower yields. (See also Table 3.)

The Strains within each Group.

For the purpose of identification a number of "strain" names have been used in Australia, and samples sent to us have been referred to

as being under one or other of twenty-five different names. The names of the strains which come within each of the Groups 1 to 4 above are as follows :—

Group 1.—(Early-flowering and low production) : Dwalganup, Daliak, Springhurst, Mulwala.

Group 2.—(Mid-season-flowering, early growth, very good production) : Burnerang, Myall, Nangeela, Bacchus Marsh.

Group 3.—(Mid-season-flowering, good average production) : Mount Barker (commercial), Mount Barker (selected), Western Australia, Kybybolite, Goroke, Wangaratta, Orford, Orford Selection, Hill's Small-seeded, White-seeded.

FIG. 6. SUBTERRANEAN-CLOVER STRAIN TRIALS.

The growth shown is the total autumn growth following re-establishment from seed shed the previous summer. At this stage rust infection occurred. The photograph shows the Burnerang in the mid-foreground comparatively unaffected, whereas the surrounding plots each show a considerable amount of rusting. Photograph taken 28th April, 1936.

[*Photo by L. W. Gorman.*

Group 4.—(Late-season-flowering, late growing, but heavy production in the late spring) : Tallarook, Romsey, Bena, Kyneton, Macarthur, Wenigup, Bass.

These names seem to indicate places of origin of these strains rather than strictly distinct strains. In Group 2 Myall and Bacchus Marsh are indistinguishable as separate strains. In Group 3 the strains Mount Barker, Goroke, Western Australia, Orford Selection, Kybybolite, and Orford are morphologically and ecologically alike.

In Group 4 the names Tallarook, Romsey, and Bena are used for three strains which appear identical in every respect.

Economic Importance of the Different Strains.

The strains in Group 1 do not appear to be suitable for use in New Zealand on account of their low total production (see Table 4) and relatively early maturity, although their autumn and winter growth has been fairly good.

Group 2 contains strains which have grown particularly well at all periods. This is shown in the following Tables 3 and 4, which give actual green weights, also in Tables 1 and 2, which have been computed from figures allotted by an eye-estimation method.

Table 3.—Green Weights of Herbage (Pure Subterranean Clover) cut and weighed on 29th November, 1935, and again on 4th May, 1936.

	29th November, 1935.		4th May, 1936.	
	Average Green Weight per Plot.	Yield relative to Group 3 = 100.	Average Green Weight per Plot.	Yield relative to Group 3 = 100.
	lb.		lb.	
Group 1	6·7	21	16·75	184
Group 2	41·32	129	17·9	197
Group 3	32·0	100	9·1	100
Group 4	44·75	140	13·4	146

The total average yield for both dates then is as shown below :—

Table 4.—The Total Average Yield of Green Material from Both Weighings.

	Total Average Yield per Plot.	Yield in Tons per Acre.	Yield relative to Group 3 = 100.
	lb.	Tons.	
Group 1	23·45	9·15	57
Group 2	59·62	23·20	145
Group 3	41·10	16·00	100
Group 4	58·20	22·60	142

The two weighings were made at periods when seasonal growth was almost completed, so the figures giving total yields practically represent one year's production from a pure sowing of subterranean clover under local climatic conditions.

Each of the strains Burnerang, Nangeela, Myall, and Bacchus Marsh, which constitute Group 2, is likely to be of considerable economic importance in New Zealand, because of the exceptionally good total production, together with good growth at seasons when any clover-growth is exceptionally valuable—*i.e.*, winter, early spring, and early autumn. In growth-form the Burnerang is quite distinct from all other subterranean-clover strains tested. The plants themselves are characteristically erect leafy bunches of very slender stems and medium-sized leaves. (All other strains are prostrate and spread laterally.) The Nangeela is more like a large-leaved strong-growing white clover. It has leaves very distinctly marked with a white band across them. Both Bacchus Marsh and Myall appear like vigorous forms of the average commercial (Mount Barker) type. The essential difference noted is that in the Mount Barker at the base of the calyx-tube of the floret there

is a distinct red-coloured band, whereas the calyx-tubes of both Bacchus Marsh and Myall are colourless at the base. The calyx-tube of Nangeela is light-green-coloured, and has no red coloration. Both the Burnerang and the Nangeela are able to make growth in the winter months and early spring, but Bacchus Marsh and Myall are more winter-dormant. The Myall is particularly good in the autumn.

Practically all of the subterranean-clover seed sold commercially in New Zealand in past years has been of the Mount Barker type. This strain, together with the others of similar type but differently named (see Group 3), can be relied upon to give reasonably good results, and

FIG. 7. SUBTERRANEAN-CLOVER STRAIN TRIALS.

Autumn re-establishment showing delayed germination and growth of the late-flowering strains. Date: 16th March, 1936.

Foreground (left to right): (*a*) Kyneton (late). (*b*) Springhurst (early). (*c*) Burnerang (early mid-season).

Second row: (*a*) Bacchus Marsh (early mid-season). (*b*) Bena (late). (*c*) Orford (mid-season).

[*Photo by L. W. Gorman.*

until superior strains are available commercially the sowing of the Mount Barker type is quite worth while. Strains within Group 3 which differ slightly from the Mount Barker are the Wangaratta, Hill's Small-seeded, and White-seeded. The Wangaratta makes autumn establishment and growth rather later than the average for Group 3. Hill's Small-seeded and White-seeded are more slender and leafy than the typical Mount Barker, but the total production of each is low.

A characteristic of Group 3 is its proneness to severe infection from leaf-rust (*Uromyces trifolii*). This was most noticeable in the autumn. Growth since the beginning of February had been very rapid, but by the end of March it had reached a stage of maturity, and at that stage the

rust attack developed. The Hill's Small-seeded strain was the most severely infected. The strains in the other groups were only slightly affected, as the following figures show :—

*Table 5.—Relative Degree of Infection by Leaf-rust (*Uromyces trifolii*) on Subterranean-clover Strains within Groups 1 to 4.*

(Heaviest infection = 100. At date 27th April, 1936.)

Group 3	100·0
Group 2	39·0
Group 1	29·0
Group 4	2·5

It will be noticed that the strains in Group 4 which were still growing were affected only very slightly. In Group 2 the Bacchus Marsh strain, which was quick-growing in the early autumn, was rather severely attacked in this respect, being much worse than any other strain outside of Group 3.

Although the strains of Group 4 give a total yield about as great as that for Group 2 (see Table 4), the herbage itself is of less economic value, since it is produced relatively late in the spring and somewhat late again in the autumn, and, further, this high production extends over a limited period of approximately ten to twelve weeks only in either the spring or the autumn. Of the strains within Group 4 the Tallarook, Bena, and Romsey were outstanding for high total production of green material. The Kyneton, Macarthur, and Wenigup gave much lower yields. Each of the extra-late strains failed to germinate and establish quickly in the autumn. The Macarthur established the most quickly, and the Tallarook, Romsey, and Bena were next. Comparatively few seeds of the Kyneton had germinated before the beginning of March, and this plot remained weak throughout the autumn. The Wenigup completely failed to re-establish itself. This was most likely due to the date of cutting and weighing (29th November, 1935) interfering with flowering and seed-setting. The Wenigup was the only strain thus to fail so completely.

Since these extra-late varieties are capable of exceedingly high production, the ecology of this group as a whole requires further study. In any case, the Tallarook, Romsey, and Bena strains have proved superior to other strains of the same group, and it is quite possible that in practice these particular strains may prove equally as good as the commercial types now in use, and most likely at certain times of the year (particularly the early summer) the Tallarook, Romsey, or Bena would excel. The Tallarook, Romsey, and Bena strains each have florets with calyx-tubes either colourless or pale green at the base, and the stipules are green-veined (many other strains are red-veined). Another characteristic feature is that while the plants are in the rosette stage—*i.e.*, towards the end of winter—that portion of each leaflet nearest the petiole is a deep-chocolate colour. This chocolate area may cover half the area of each leaflet. Later in the spring this chocolate colour disappears.

Strains in Commerce.

Until recently practically all of the subterranean-clover seed sold in New Zealand was of the Mount Barker type, but now Australian catalogues list supplies of the Dwalganup early and the Tallarook late

as well as the Mount Barker mid-season strain, and it is known that some hundredweights of Tallarook seed have reached New Zealand this year. There is no direct report of any Dwalganup seed having been sown in New Zealand, but it is important to note that although this strain is being certified to by the Western Australian Department of Agriculture, and is specially recommended for use in districts of less than 20 in. of annual rainfall, where early maturity and seed-setting is essential, there is every indication that this strain is unsuitable for use in New Zealand.

Conclusion.

From a study of existing strain differences a classification of strains into well-defined groups has proved possible.

Burnerang, Myall, Nangeela, Bacchus Marsh, Tallarook, and Mount Barker appear to be strains well worthy of extended experiment and field trial. Botanical characters which aid identification of each of the above strains have been given.

Unfortunately, seed-supplies of Burnerang, Nangeela, Myall, or Bacchus Marsh are not available in commercial quantities, but at the present time while we are studying these strains we are also growing seed-increase blocks of the most promising strains. When seed-stocks are available it will be essential to have the growing, harvesting, and distributing of these strains protected by a system of seed certification.

LUCERNE-GROWING IN THE AUCKLAND DISTRICT.

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During the past few years a marked increase in lucerne acreage in the Auckland district has taken place. Whereas in 1929 a total of 2,667 acres was devoted to this crop, the acreage in 1935 had risen to 5,248. Of these totals, North Auckland had 210 acres in 1929 and 429 in 1935, while the acreages for South Auckland in the corresponding years were 2,457 and 4,819. These figures suggest that, so far as North Auckland is concerned, the crop is relatively unimportant at the present time. The reasons for this may be summarized as follows :—

(1) In the north the soils for the most part consist of stiff clays, which remain wet during winter months and dry out hard in the summer. They do not permit of free root-penetration, and consequently are not suitable for lucerne. In some districts there are restricted areas of basic volcanic soils sufficiently free to be favourable for lucerne growth. Such soils grow good crops, giving up to six cuts per annum over a period of three or four years, and occasionally longer, before they are invaded by paspalum and weeds.

(2) Crops are frequently affected by stem rot (*Sclerotinia* sp.), which rapidly spreads through the field, especially where cultivation of the stand is practised.

(3) In view of the high rainfall and the uncertainty of weather conditions, harvesting for hay is seldom done satisfactorily. Too many crops are spoiled through being treated as ordinary pasture-hay instead

of being allowed to cure in cocks. Consequently, the lucerne-hay crop is usually a mass of dry stalks devoid of leafage, and, as such, has little feed-value.

(4) The soils of the north where lucerne thrives are also well-suited for paspalum, which many successful farmers consider superior to lucerne. Furthermore, the clay soils can also be induced to grow good paspalum. Consequently, when it is remembered that paspalum does not present the same problems of management, establishment, and renewal, it will be readily appreciated why the northern farmer shows preference for this grass.

In the north there are restricted areas where lucerne does well. In such localities it proves quite useful in providing green feed, especially where paspalum is not well established. Likewise, on poultry-farms and small farmlets run in conjunction with orchards an area of lucerne is often grown to provide green feed during summer months, while silver-beet, kale, or chou moellier are used in the winter.

In the South Auckland district lucerne is more favourably regarded. Rainfall, while not so high as that in the north, ranges about 50 in. per annum. Paspalum also thrives, particularly in the Bay of Plenty. It is in the types of soil that South Auckland districts show greatest variation from the north. Whereas stiff clays are dominant in the north, pumice types are most commonly encountered in South Auckland. Practically the whole Bay of Plenty district, extending from the coast on the north to Taupo on the south, and much of the Waikato consists of free pumice soils, while just south of Auckland fairly free basic volcanic soils are to be found. Areas of peat, unsuitable for lucerne, are also scattered throughout these districts.

On the open soils lucerne establishes well, and the free nature of the subsoil permits of good root-penetration. Excessive wetness in winter and summer baking are practically unknown. Experience with the crop has shown that four or five good cuts per annum can be expected on well-managed fields. As in the north, there are parts of the Bay of Plenty where paspalum in association with perennial rye-grass and white clover is to be preferred to lucerne. Generally speaking, these areas are of high fertility where soil-moisture during summer is adequate for maximum paspalum-yield. There are other areas in this district, however, where the upper levels of the soil are far too dry in summer for high production from paspalum. On such soils lucerne, with its deeper root-penetration, proves more suitable. It is not claimed that all these soils yield heavy crops. Some are far too low in fertility to do so, but their returns in lucerne are much greater than they would be in paspalum. There has been a pronounced increase in the acreage of lucerne in the Bay of Plenty, and this has also applied in parts of the Waikato, particularly in the counties of Matamata, Piako, and Waipa.

Cultivation.

On many farms the initial ploughing is delayed until late in the spring, after which disking, harrowing, and rolling follow at short intervals just prior to sowing down. This type of preparation leaves much to be desired, and many of the failures in establishment could be traced to hurried and inefficient cultivation. A good fine seed-bed does not result from hurried work. Ploughing should be done in the winter, and

further working with disks and harrows should be completed in mid-spring. Such working gives reasonably good fineness, after which a roller can be used freely to obtain good consolidation. Where a roller is not available, use is occasionally made of stock to tramp the proposed lucerne field after the cultivation has been completed.

Rate of Seeding.

Where seed is being broadcast it is customary to sow from 20 lb. to 25 lb. of seed an acre, and occasionally seedings range up to 30 lb. per acre. If drilled, the usual sowing is from 16 lb. to 18 lb. per acre. With these heavier sowings good strikes are obtained, but there is a tendency to overcrowding. Tillering is restricted, weakened plants are common, and frequently there is fairly high plant mortality in the first year or two. The object underlying heavy seeding is to smother weeds, but measures to eliminate weeds prior to sowing would give better results. This could be accomplished by somewhat later sowings following continued cultivation to destroy seedling weeds as they appear. Under this method of preparation suitable seedings would be provided by 18 lb. to 20 lb. an acre broadcast and 14 lb. to 15 lb. an acre in 7 in. drills.

Method of Sowing.

The usual practice in the Bay of Plenty is to broadcast seed through a top-dresser, the seed being previously mixed with carbonate of lime or a mixture of superphosphate and lime in equal proportions. Where the areas are very small they are often hand-sown. In a few instances an ordinary grain drill is used, but, in view of the fact that little cropping is practised, few drills are available. Fortunately, lucerne establishes well when broadcasted on Bay of Plenty soils. In the Waikato, however, drilling of the seed appears to be essential to success: the usual practice in this district is to sow about 16 lb. seed per acre, drilling half the seed in one direction and the rest across the first sowing. Broadcast stands in the Waikato are often unsatisfactory the second year after establishment.

Inoculation of Seed.

There is little doubt of the necessity to inoculate lucerne in South Auckland districts. Numerous instances of failure resulting from sowing untreated seed could be quoted. Since the introduction of the Department of Agriculture's culture for treating seed, this material has almost entirely superseded other cultures and the soil-method of introducing bacteria. In view of the fact that stem rot (*Sclerotinia* sp.) causes widespread damage on many lucerne-fields in South Auckland, it is always dangerous to use soil as the means of inoculating a further lucerne area. This is being appreciated by the farming community, and has led to a definite preference for the inoculating cultures.

Manuring.

The usual practice is to sow from 5 cwt. to 1 ton of carbonate of lime an acre a week or so before seed-sowing. This is followed by 3 cwt. to 5 cwt. of superphosphate an acre either just prior to or immediately following the sowing of seed. A good proportion of farmers sow the superphosphate mixed with lime together with the

seed. The manurial practices appear to be quite sound, although a more general sowing of lime at not less than 1 ton per acre would be regarded as sounder practice. Lucerne definitely requires a non-acid condition, and lime, in sufficient quantity, can provide this condition in the soil.

Time of Sowing.

Lucerne is sown in both spring and autumn. Spring sowings are much more popular, as considerable difficulty in getting good establishment is experienced with autumn sowings. With spring sowings it is not uncommon to find areas being laid down from mid-September to mid-December. Most of the crops, however, are sown during the first fortnight in November. The very early-sown crops are usually smothered by spring weeds, and seldom show satisfactory results. Where it is known that spring weed-competition is likely to be a problem, early cultivation and further continued cultivation into December is certainly the best procedure to adopt in an endeavour to rid the land of weeds. Where consolidation is good there is seldom any difficulty in obtaining good strikes from December sowings.

Autumn sowings cannot be recommended: heavy plant mortality occurs, and the farmer usually finds that he has to resow the field in the following spring.

Crop Cultivation.

In the management of a lucerne-field consideration has to be given to the problems affecting each particular area. In some fields annual weeds are the chief problem. In others, twitchy grasses present difficulties, while in still others disease demands attention. It is obvious that such variation in problems demands similar variation in method of attack, and yet it is not uncommon to find lucerne suffering from all the above drawbacks on as many different farms receiving the same treatment. Let us consider mechanical treatment. Not uncommonly, lucerne-fields are well cultivated and manured in August. If the chief problem happens to be annual weeds, this proves satisfactory. If, however, Indian doobj has to be contended with, such treatment merely rejuvenates it. Harrowing under these circumstances should have been delayed until January, when the hot dry weather assists in eradicating the weed. Where disease has invaded the field, any harrowing merely spreads it through the crop and hastens the destruction of the stand. Partly for this reason Waikato farmers, and a proportion of Bay of Plenty growers also, have discontinued harrowing and cultivating lucerne. In order to maintain vigour in the crop they rely on liberal phosphatic manuring.

Grazing.

Generally speaking, grazing of lucerne should not be carried out, although there are times when feed shortages, pressure of farm-work, or shortage of labour make it difficult to avoid. Apart from the danger to stock, considerable damage can be done to the lucerne if unduly punished. Where it is known that lucerne will be grazed, the crowns can be protected if the previous cut is taken somewhat

higher than usual. A fairly stiff stubble is thus produced, and is sufficient to keep stock away from the crowns for some little time.

Apart, however, from the damage to the lucerne-plant, stock-tramping brings about surface consolidation, which leads to invasion by grass and weeds, and often results in a marked reduction in yield.

Summarized, then, the position of lucerne in the Auckland District may be stated as follows :—

(1) In North Auckland the soil types and rainfall make paspalum-growing generally a more certain means of providing feed than does lucerne-growing.

(2) In South Auckland the soils and climatic conditions are suitable for the crop. Parts of the Bay of Plenty, however, are more adapted to paspalum than they are to lucerne.

(3) Success with the crop depends upon thorough cultivation, good consolidation, and spring sowings.

(4) In the Waikato drilling of the seed is essential to success.

(5) On all soils in the Auckland district inoculation of the seed or soil is necessary. The cultures obtainable from the Department of Agriculture are highly effective for this purpose.

(6) Liberal liming and manuring with phosphatic fertilizers is always desirable, especially at establishment.

(7) Grazing of lucerne is not desirable: it leads to grass and weed invasion.

(8) Cultivation should be regulated to suit the particular crop. Where stem rot is prevalent liberal manuring should replace any form of cultivation.

This article summarizes papers on lucerne-culture in the Auckland Province read at the 1936 Conference of the New Zealand Grassland Association by R. P. Hill and C. Walker, of the Fields Division of the Department of Agriculture.

SHEEP-PRODUCTION ON THE MOUNTAIN COUNTRY OF ASHBURTON COUNTY.

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The sheep-runs of the Ashburton County cover roughly 590,000 acres of river-flat, foothill, and high mountainous country bounded on the south by the Rangitata River (with the exception of the Mesopotamia run of Butler's "Erewhon" fame). On the northern side the boundary is formed by the Rakaia River, and a straight line from the Rangitata through Mount Somers and Staveley Townships to the Rakaia roughly demarcates the plains land from the hills on the east, while westerly the runs extend back thirty and forty miles to the main ranges of the Alps.

On account of the extreme roughness of the country and the lack of suitable vegetation, the sheep do not graze on the high faces of the main range. Nevertheless, the Merino is mustered from the summer country at levels between 7,000 ft. and 8,000 ft., and within the shadow of the glaciers.

An important feature of the hill country of this county is the abrupt commencement of the high hills and the small amount of foothill country—*i.e.*, there is very little of that type of country which is sufficiently good and free from snow to maintain a ewe flock the year round and to dispose of wether lambs and surplus ewes for fat-lamb production on the plains—*e.g.*, between the Rakaia River and Mount Somers Township, which is roughly the northern half of the run country joining the plains, the total grazing capacity of the country that is able to carry only ewes and ewe hoggets and no wethers does not exceed 3,000 acres. Two-thirds of this number are on small grazing-runs leased by men who winter their ewes on farms within a few miles of their runs. Between Mount Somers and the Rangitata River a little more foothill country is present. The carrying-capacity of this area is roughly 28,000 ewes and ewe hoggets, and of these about 17,000 are on pastoral-run country. The remainder are on freehold runs. The total number of sheep grazing the whole area, including the foothill mountain country mentioned above, is about 173,000, of which only about half are ewes and ewe hoggets. The figures given serve to emphasize the point that the ewe country is small in area. This will again be seen when the importance of the runs as a source of surplus wethers and wether lambs for fattening and surplus ewes for fat-lamb production is discussed.

Vegetation, Rainfall, and Topography.

The runs of the Ashburton County lie behind, and are a modified extension of, a belt of brown-top country which has been depicted in Dr. Hilgendorf's map of the South Island showing the distribution of the various plant associations that are to be found. The aggressive nature of the brown-top is plainly seen throughout the run country, where it is a common exotic grass, and, together with fescue tussock, forms the chief members of an association formed by Yorkshire fog, sorrel and catsear, and the two previously mentioned grasses. Cocksfoot and suckling clover are found on the better areas. The heath, Leucopogon, *P. Colensoi*, and sweet vernal are found on the drier sunny parts. The snow tussock, *D. Raouli*, is common. The aggressive nature of the brown-top is also plainly seen in the cultivated areas, where a paddock which has been sown down with perennial rye-grass and clover three to four years previously is a sod-bound mass of twitch, while old paddocks are seen which have been laid down for many years and show no signs of reverting to the native tussock. Not only in the cultivated areas, however, which are a very small portion of the total, does one find this grass, but throughout the tussock flats and slopes. The successful establishment of brown-top is undoubtedly due to many factors. The soil is silty, not rich in quality, and inclined to be sour. The north-west showers make eradication difficult, while burning affects it less than the other grasses present.

The rainfall of this area is extremely variable, and unfortunately the rainfall gauges in existence are mostly situated at points around the edge of the hill country. It is a fact, however, that the north-west showers are very local and fall off rapidly as one travels from west to east. At Double Hill, for example, the average is 61 in. and the annual fall was 70 in. in 1934, while at Mount Somers the average is 38 in. and at Alford Forest 46 in., a distance of about 40 miles as the crow

flies. As one travels east to the plains, so also the south-west rains become greater, but it is the summer nor'westers that frequently delay shearing and promote the survival of brown-top.

With the exception of the Alford Forest, situated on the edge of the hill country, the bush is confined to a few beech gullies, often insufficient to supply fuel.

The country consists of hills and high ranges lying between the gorges of the Rakaia and Rangitata Rivers. There is not, however, any definite arrangement of main range with subsidiary spurs leading to the plains. On this class of country the aspect of the land is all-important. The slopes facing north or north-east determine the amount of winter country—*i.e.*, country on the lower slopes of which the flock can be maintained during the period May–August reasonably safe from snow, or where the snow does not lie deeply for a long period. Flat land in this class of country has not the significance as when it is good agricultural land, since a run may have a large area of flat consisting of worthless river-bed or silt-flat which, with a slight slope from the sun, will be colder and wetter than a high slope facing to the sun.

Carrying-capacity of the Hill Country.

The carrying-capacity of the runs surveyed varies considerably both in sheep per acre and the proportion of ewes to wethers. It is possible to grade the country into four main types and to indicate what variations exist. They are as follows :—

(*a*) *Half-bred Ewe Country*, which comprises downs and the best of the foothill country and covers about 11,000 acres, and which carries one sheep to the acre, and winters the hoggets with supplementary crops, hay, &c.

(*b*) *Half-bred Ewe Country with little or no Ploughable Land.*—This grade of country winters the ewes and carries one sheep to from 1 acre to 3 acres, except during the winter months, when the hoggets are sent to the plains. This type of country is slightly higher and rougher, and the hoggets are wintered away, either because there is not the shelter country for both ewes and hoggets, or because there is not a suitable area for growing turnips. This grade comprises about 40,000 acres, and carries about 19,000 sheep.

(*c*) *Half-bred Ewe and Wether Country.*—On this grade there is a considerable area of rough country suitable only for wethers. The hoggets are wintered away, but exceptions occur where there is good turnip-country and the hoggets are retained. The country runs one sheep to from 2½ acres to 4 acres. This country comprises about 159,000 acres, with a total of 59,000 sheep, of which 20,000 are wethers, the proportion of wethers to ewes varying from about one-third to one-half.

(*d*) *Merino Country.*—This comprises the roughest area, liable to snow and bounds on the unused country. The barren areas are large and have to be mustered for stray mobs of wethers. The carrying-capacity is not, however, below that of the half-bred country when calculated on the area of grass only. The number of wethers is about 31,000, with a total of all sheep of 81,000 on an area of about 233,000 acres—*i.e.*, one sheep to from 2½ acres to 4 acres. The hoggets and two-tooth ewes are wintered on the plains in all cases.

The following table gives the number of sheep of each breed or type, &c., and where a change is in progress the flock has been placed in that type which it is hoped to attain :—

Breed or Type.	Number of Sheep.	Number of Flocks.	Range of Size of Flocks.	Number of Ewes and Hoggets.	Number of Wethers and Rams.	Acreage of Grass.	Lambing Percentage.
Merino	81,300	7	5,000–25,000	50,000	32,000	233,000	70
Corriedale	26,301	2	4,000–22,000	18,000	7,000	68,000	69
Romney-Merino half-bred ..	42,500	14	300–10,000	39,500	3,500	66,700	80
English Leicester - Merino half-bred	29,750	6	100–17,000	20,000	7,800	92,800	75
Totals	179,851	29	..	127,500	50,300	460,500	..

The lambing percentages on this type of country are variable from year to year both on and between runs. The variation is in the neighbourhood of 10 per cent. This has a direct effect on the number of surplus stock disposed of in the following autumn in order than stock numbers may be maintained.

Methods of Management.

The management of this class of country is governed by the following matters : (1) Proportion of winter and summer country previously mentioned ; (2) subdivision fences and natural boundaries such as creeks, high ridges, rock-bound gullies, &c. The importance of adequate fencing for the spelling of winter country, complete grazing of summer country, and the separation of wethers, ewes, and hoggets in order that the fullest use may be made of the country, deserves greater attention than it receives in many cases. It is true that runholders are still recovering from the effects of the slump, and that fencing on this type of country is a costly business—£80 to £100 a mile—yet the advantages of fencing are many. The sheep and cattle make the fullest use of the summer country and are prevented from drifting back on to the winter country. The wethers can be kept back on the roughest areas, lambs can be weaned on to a clean spelled block, while a snow fence, preventing the sheep from drifting up into higher basins in the late autumn at the time when snow is due, is a valuable means of preventing mortality and the expense of snow-raking and mustering.

A further point with regard to fencing is the very limited use of cattle on these runs. In many cases the grazing of cattle as a means of control of rank growth in the gullies and flats instead of indiscriminate burning would be a better practice. The objection usually put forward is that the existing fences are not suitable, and the cost of erection of barb wire prohibitive. It appears desirable that some modification of the present system of owners erecting fencing subject to the right of compensation should be introduced. This system tends to hamper the man with a small capital. The reduction in mortality alone would, in many cases, pay the interest and sinking fund on a substantial amount of capital advanced for fencing.

Fencing is also the chief cost in the establishment of plantations and shelter-belts, and, while one usually finds a well-grown belt around the homestead, it is rare to find one elsewhere on the property. As these lands are extremely subject to the north-west winds, crops of hay and oats are often difficult to harvest, while cultivation in the spring

may be hampered by the danger of the paddock "blowing." Again, as a way of providing a future source of timber and a shelter for stock, the establishment of shelter-belts and plantations is desirable.

Supplementary Crops, Hay and Chaff.

The area subject to cultivation is very small in comparison with the total areas of each run. In some instances no cultivation is carried out. Under both sets of conditions the hoggets are, with exceptions, wintered on the plains by farmers who grow turnips especially for this purpose. This aspect of sheep husbandry will be discussed in a subsequent section. Where cultivation is carried out, supplementary crops consist solely of the various types of turnips, but usually the white-fleshed variety is raised since the growing-season is short. The ruling practice is to plough out of grass in the late autumn or early winter, fallow until spring, and cultivate the seed-bed for sowing in December and January. The land is left in the roughest possible manner through the winter, as a fine surface lifts with the frost and "blows" with the drying north-westers. Turnips are usually sown alone the first year, fed-off during winter, and the land ploughed again the following spring. This time turnips, perennial or Italian rye-grass, and red clover are sown, and in this way the paddock is grassed down again, forming a source of hay the following year.

Oats are grown as necessary feed for the team, hacks, and pack-horses. The usual oat variety is Garton's, and the crop is spring-sown. Autumn sowing is not satisfactory, owing to the severe winter. The oat crop is sometimes sown with grass as a means of getting the land back into pasture again.

It is probable that the establishment of cocksfoot would meet with success: one or two instances of excellent cocksfoot stands have been seen. It can be said that there is need for better pasture-establishment and pasture-management, and use of hay.

The small area of turnips grown on the run country (about 1,000 acres) is, of course, quite inadequate for the needs of such country, but climatic factors are involved which may have serious consequences. For example, where turnips are relied upon in winter the paddocks are liable to be covered with snow or at least frozen hard for days, and turnips under these conditions are of little value, especially for hoggets, which are extremely difficult to handle in snow under extensive conditions where sufficient hay or chaff to feed over a period to a large number of sheep is not carried. On most runs the amount of winter country which is "safe" is inadequate to carry hoggets and ewes without a reduction of the flock or risk of serious loss. This difficulty is surmounted by migrating the hoggets to the plains from May to August, where they are placed on turnips in various localities. This can be said to be a specialized aspect of sheep-raising. Suitable areas for turnip-growing exist where farmers produce this crop and sell at so much per acre, or per week, the farmer tending the hoggets and moving them to a "run-off" when required. In a few instances a runholder has his own farm on the plains. There are some points in connection with this migration which require consideration:—

(1) The Cost: The average cost of grazing on turnips is about 2d. per head per week for hoggets and 3d. per head for ewes. The buying of turnips on the plains means a considerable cash outlay—*e.g.*, with a

scarcity of turnips through crop failure the runholder will pay about £5 per acre, and 2,000 hoggets will require about 50 acres. In addition, a certain amount of hay is usually bought, while droving may cost £25 or thereabouts—*i.e.*, roughly, £300 is incurred, or 3s. per hogget. This is a conservative estimate.

(2) The tussock hogget is healthy and apparently not infected with parasites to any extent, while losses on turnips are sometimes considerable, and in wet weather sufficient hay is not on hand to maintain the sheep without turnips. Some runholders maintain that, providing a tussock block sunny and free from snow is available, it is better to send to the plains two-tooths and older ewes, which have a better resistance to parasites, and keep the hoggets on the sunny blocks of the run. Against this is the argument that the hoggets thrive better in the comparatively mild plains climate. In all cases, however, the winter migration allows a higher carrying-capacity, or, what amounts to the same thing, less mortality. As an example of this, a case is known where all sheep were wintered on the run, and the death-rate was 20 per cent. to 30 per cent. With a change in ownership the country was adequately fenced and the hoggets taken out to the plains. The death-rate is now 4 per cent., the same number of stock go into the winter but a large surplus is sold, and by adequate winter feeding of hay, &c., the wool clip has been doubled. The increase in wool clip may be correlated with the introduction of excellent sires, but no Merino flock will clip an average of 10½ lb., which is obtained in the case quoted, without attention to all factors concerned. It is the general opinion that stock numbers would have to be reduced one-fifth or more if the hoggets or ewes were not away for the four winter months. The small area of turnips grown on the run is fed to hoggets before going away to the plains or fed to the rams during winter. Again, in some cases they are conserved over winter for the hoggets in early spring when they return from the plains. It is estimated that about 22,000 hoggets and ewes are migrated annually, and some of these travel for a week in order to reach their new pasture.

The Mountain Area of Ashburton County as a Source of Surplus Sheep.

The type of sheep carried on the plains farms of the county is largely the half-bred and fine three-quarter-bred which are mated to the English Leicester and Southdown ram for fat-lamb production. The run-country ewes are in keen demand for this purpose, coming from the hard hill country. They improve greatly in condition and have a sound constitution. The following figures indicate approximately the number and class of surplus sheep which are disposed of each year:—

Ewes (mainly full-mouth)	16,000
Wethers, store lambs (mainly wethers)	8,500

The ewes are disposed of at the Methven and Tinwald ewe fairs in March. Wethers are sold soon after shearing to private buyers. Similarly, the store lambs are drafted out at weaning-time in March and go to the plains for fattening on turnips.

Breeds of Sheep found on the Runs.

On such country as that of the Ashburton tussock land personal likes for any particular breed are restricted by the vigorous environment

to the Merino and its derivatives. There is, however, sufficient variation in climatic conditions to warrant the variations found within the area surveyed, although the method employed in obtaining a desired type may give rise to a good deal of undesirable variation, and instances occur where a run has fallen into the hands of men ignorant of the prevailing conditions who have introduced unsuitable types, with subsequent heavy mortality and disaster.

The following is a list of the types found, together with the number of flocks of each type :—

Breed or Type.	Number of Flocks.
Merino	7
Romney Marsh half-bred ..	14
English Leicester	6
Corriedale	2

Included in this list are four small grazing-runs which carry a few hundred ewes for eight months of the year and are grazed in conjunction with plain lands. These are situated between Mount Somers and the Rakaia River, close to the Alford Forest. The land is sour and wet, and Romney half-breds are carried on three of the runs.

In some instances a change of type is now in progress—*e.g.*, the Romney Marsh half-bred ram is being introduced into an English Leicester half-bred flock. Other instances are seen where the Merino ram is being mated to the half-bred ewe, which produces a come-back type of lamb. These in turn will be mated to the Merino ram, and so on. The production of a half-bred with certain desirable characteristics found in the Romney strain or the production of a Merino flock being the end in view. The mating of the coarsest-woolled half-bred ewes to the Merino ram, the progeny of which cross would be sufficiently fine in the wool to be mated back to a half-bred ram, is also a means whereby the breeder endeavours to obtain a type with the characteristics he considers suits his conditions yet gives him the maximum cash return. It is important to note, also, that in a very few cases does the farmer with the half-bred flock breed his own rams. He purchases them from a local breeder, who in turn has bred them from cast Merino ewes which he purchases from some Merino breeder.

Consideration of these breeding practices brings into prominence the variations which from genetic considerations must occur and in actual practice are known to appear, and which, by means of scientific methods, could be selected for and established in desirable types. The production of a polled type of Merino and the standardization of suitable types of half- and three-quarter breds are examples of problems which will possibly be encompassed with the aid of scientific methods in the future.

Most of the stations have large areas of barren country, shingle, and rocky tops, &c. On this type of country it is desirable to select a type possessing a close fleece, which will prevent the ingress of sand. Here the half-bred is at a disadvantage compared with the Merino. The whole problem is, of course, bound up with the value of surplus stock for fat-lamb raising. The Merino ewe or wether lamb is not as valuable as

the half-bred, and the lambing percentage of the Merino is usually about 10 per cent. lower than that of the half-bred. In addition to this, the slower-maturing Merino is not put to the ram until she is a four-tooth. The half-bred ewe in some cases is put to the ram as a two-tooth, but the ruling practice in the county is to draft off for mating the well-developed two-tooths, which on the harder country will be about 50 per cent. of the total.

The Merino is, however, a better sheep for the snow than the half-bred, and musters off the high country better. Slightly more Merinos can be carried on the same area. The man utilizing half-breds has, however, the satisfaction of knowing that if the price of wool fails seriously he still has a second string to his bow in the superior half-bred carcass.

The preference for the Romney half-bred is on those runs which, although not the roughest, tend to face from the sun and to be wet and sour. These conditions arise on the front country around Mount Somers, and on such country the Romney half-bred is hardier and gives a slightly better lambing percentage, and it is favoured by store-lamb buyers and the purchasers of mature ewes for fat-lamb production. This conclusion has been arrived at not only by the comparison of different flocks on different runs, but by the experiences of men who ran the English Leicester half-bred and have since changed to the Romney strain on the same country.

Conclusions.

(1) There is considerable variation in existing types of sheep and breeding methods employed. Improvement by selection and fixation of suitable types would be an advantage.

(2) In many instances fencing is inadequate, and there is need to facilitate the following points of management :—

(*a*) The use of summer and winter country, with the conservation of winter feed, and to reduce the risk of stock losses through snow.

(*b*) That a depleted area be spelled, and the seeding of existing vegetation be allowed.

(*c*) To extend the use of cattle as a means of control of rank growth rather than indiscriminate burning. Burning once every three to four years, except where growth is rank, is considered sufficient.

(*d*) That the establishment of plantations and shelter-belts be extended to provide timber, to shelter stock, and to facilitate cultivation under adverse conditions.

THE CHINESE GOOSEBERRY.

J. W. Whelan, Orchard Instructor, Palmerston North.

The Chinese gooseberry (*Actinidia chinensis*) is related to a family of climbing shrubs often cultivated for their handsome foliage, and at times for the edible fruit produced on some species.

Actinidia chinensis is a deciduous, dicœcious, climbing shrub or vine. Although recognized as being frost-tender, it appears to withstand light frosts fairly well. Apparently this plant is cultivated to some

extent in Central China, from which country it was introduced to New Zealand. Although it is not extensively cultivated at the present time, it may be grown successfully in certain portions of this Dominion, not only for ornamental purposes, but with profit to the grower, as the fruits—commonly known as Chinese gooseberries—find a ready sale with an increasing demand at 6d. to 9d. per pound.

It is of very vigorous growth and comes into bearing the third year, if propagated by grafting. The current year's growth is dark-green in colour and covered with a mass of short hairs of bright red colour: later this colour changes to brown. It is quite a common occurrence for eight to ten vine-like growths to develop from the one stool during the growing-season. Such growths may vary from 18 ft. to 21 ft. in length.

Propagation.

Young vines are easily raised from seeds. However, this method of propagation is not recommended because it is impossible to differentiate between male and female plants until flowering has occurred. Propagation by grafting is recommended. Many nurserymen propagate by grafting, and as a result it is now possible to purchase a guaranteed pair, male and female. Apart from the necessity of planting a vine of each sex, necessary for the production of fruit, grafted vines come into bearing at least two years earlier than seedlings. Both sexes grafted on the one stock have proved successful: this may be achieved by grafting a strong female scion and a weak male scion on the same root.

Fruit.

The fruit is produced on one-year-old and older wood. It varies in shape from almost round to oblong. It is brown in colour, and covered with a comparatively tough skin which is studded with a mass of short hair-like growths. The flesh is soft, dark-green in colour, with numerous minute seeds arranged around a white soft core. When fully ripe the white core disappears. The flavour is very similar to that of an ordinary well-ripened gooseberry of the greengage variety. Harvesting takes place from about the end of May to mid-June. Usually at this time the vines are bare or practically bare of leaves, and the fruit being fully exposed may be picked easily. It keeps for four or five months, and may be utilized for jam and jelly. It provides a fresh dessert fruit during the winter months.

Culture.

Rich, loamy soil, well drained, appears to be ideal for this plant, notwithstanding the fact that once the fruit has formed a good water-supply for the development of large fruits is essential.

Apparently there are no pests or diseases attacking the vines at the present time.

There is some scope for experimental work in respect to the pruning and general treatment of this plant. At the present time little or nothing is done with the exception of training the vines along wires or over trellises. Pruning may or may not be beneficial in improving the quality and quantity of the fruit. It should, however, facilitate cultural operations.

The question of laying out a plantation to the best advantage requires careful consideration, particularly in respect to the distance

FIG. 1. DEPICTING A PORTION OF THE PLANTATION WITH, IN THE FOREGROUND, ONE OF THE POLES SUPPORTING THE WIRES.

Note the fallen leaves on the ground, a normal condition at harvesting-time.

FIG. 2. PHOTOGRAPH OF A FRUIT-BEARING LATERAL TAKEN FROM THE SAME PLANTATION.

This lateral was carrying fifty fruit when first taken from the vine. Note the furry appearance of the fruit, due to short hair-like growths.

apart for planting, the method adopted for training the vines, and the number of female vines to each male vine. The accompanying illustrations, taken in a commercial Chinese gooseberry plantation at Wanganui, give a very good indication of the prolific crop that may be anticipated when grown under favourable conditions of soil, climate, and cultivation.

The plantation consists of sixty vines set out in stools 9 ft. apart on the square, one male to six female vines. Alongside each stool a pole 8 ft. high from the ground-level is erected. Ordinary No. 8 fencing-wire is stretched along the top of each row of poles each way, the ends of the wires being anchored in the ground. This arrangement allows each vine to climb up its respective pole and then along the overhead wires. Two tons of fruit, it is estimated, were gathered from this plantation during the 1936 harvest.

A suitable site for a plantation probably is one with a northerly aspect, immune from frost if possible, fully open to the sun, well drained, and adequately sheltered from prevailing winds. It is reasonable to suppose that beneficial results would follow the cutting-away of all weak and superfluous growths, and confining the number of vines or rods to, say, six or eight per root. It may also be found advantageous to shorten back the vines, and instead of allowing them to ramble at will to train each one along a wire or trellis. There also appears to be scope for experiment relative to the distance apart for setting out vines: the present method of 9 ft. apart seems much too close on a rich soil, and results in a tangled dense mass of growths. As one year's growth of each rod or vine may reach a length of approximately 20 ft., it appears that the vines might be set out at about 20 ft. or 25 ft. apart.

Introduction of the Chinese Gooseberry into New Zealand.

Over twenty years ago a gentleman living at Wanganui raised plants from seed that he imported from Central China. Many of these plants he distributed to friends living in different parts of the country, three vines going to Fielding. At this time little was known regarding the habits and nature of the plant, or that to produce fruit it was necessary to plant both sexes in proximity, for fertilizing purposes. As it happened, however, of the three vines that went to Fielding, one proved to be a male (possibly the only male raised from the imported seed). These three vines thrived, and in due time produced fruit. So far as is known, these are the only original vines which survived and bore fruit.

WOOL INDUSTRY PROMOTION ACT, 1936.

This Act imposes a levy on all wool produced in New Zealand, the proceeds of which are to be utilized for advertising or publicity purposes and for wool research, with the object of increasing the production and use of wool.

The Act provides for the setting-up of a Committee called the New Zealand Wool Publicity Committee, a body corporate, which is charged with the administration of the proceeds of the levy, and which consists of one Government representative, four wool-growers' representatives, and two associate members—namely, the Director-General of Agriculture and the Secretary of the Department of Scientific and Industrial Research. All

members other than the associate members are appointed by the Governor-General, the wool-growers' representatives being appointed on election by the wool-growers of the Dominion in accordance with regulations to be prescribed ; but pending the enactment of the necessary election regulations, and with a view to the early appointment of members of the Committee, the first members to represent the wool-growers may be appointed on the recommendation of the Minister of Agriculture, to hold office until 30th September, 1937. The personnel of the Committee so appointed is as follows :—

H. M. Christie, M.P., Waipawa, Government Representative, and Chairman.
H. D. Acland, Esquire, Christchurch, Wool-growers' Representative.
B. E. H. Tripp, Esq., Timaru, Wool-growers' Representative.
A. W. Douglass, Esq., Waikouaiti, Wool-growers' Representative.
Sir William Perry, Masterton, Wool-growers' Representative.
A. H. Cockayne, Esq., Director-General of Agriculture, Associate Member.
Dr. E. Marsden, Secretary, Department of Scientific and Industrial Research, Associate Member.

The Associate members have full rights of discussion at meetings but no voting-powers.

The functions of the Committee are—(*a*) To promote the use of New Zealand wool in existing or new markets by such methods of publicity or other means as commend themselves to the Committee ; (*b*) to promote, by way of subsidy or otherwise, scientific or industrial researches in relation to wool or sheep with a view to improving the quality of New Zealand wool or increasing its production, or the discovery of new or improved methods of utilizing it, or generally in connection with the wool-production industry ; (*c*) to act in combination or association with similar bodies overseas having similar functions.

The levy imposed by the Act applies to all wool produced in New Zealand which is either exported or delivered to a wool-manufacturer for use in New Zealand. The Minister of Agriculture is required to fix the rates of the levy for each season ending 30th September, but the rates so fixed must not exceed 6d. per bale, 3d. per fadge, and 1d. per bag or sack. The rates of the levy fixed by the Minister for the current season are the maximum rates prescribed by the Act. In the case of wool exported the levy is payable to the Collector of Customs at the port of entry for export. In the case of wool intended for use in New Zealand the levy is also payable to the Collector of Customs by the wool-manufacturer acquiring the wool. Every wool-manufacturer is required to render to the nearest Collector of Customs a monthly return of the quantity of wool delivered to him, and the amount of the levy must accompany the return. All amounts paid in levies are deemed to have been paid on behalf of the wool-grower, and may be recovered from the wool-grower accordingly. An allowance for the levy to be paid by the eventual exporter or by the wool-manufacturer may be made in all transactions of sale and purchase of wool so that the levy shall, in fact, be borne by the wool-growers, whose representatives have full control over the disposal of the proceeds, less the cost of collection by the Crown.

The Committee in the exercise of its powers and functions may apply its funds in payment of the travelling-expenses of members (not being officers of the Public Service), the salaries of officers of the Committee, and the fees or other remuneration of members in respect of their services. The amount of such fees or other renumeration must, however, be approved by the Minister of Agriculture.

—A. E. Morrison, Solicitor, Department of Agriculture, Wellington.

GOVERNMENT OFFICIAL HERD-TESTING.

In the summary of the 1935–36 season's work appearing in the January, 1937, *Journal*, Table 1, on page 34, gives a wrong set of figures under the heading *Season 1935–36*: The correct figures are as follows:—

All Purebred Cows on Test 180 Days and over, Season 1935–36.

Breed.	Number of Breeders.	Number of Cows.	Average Yield for Season.		
			Days.	Milk.	Butterfat.
Jersey	156	1,259	286	6,062·1	332·56
Friesian	15	363	289	8,850·1	315·38
Milking-Shorthorn ..	4	105	282	7,612·2	313·24
Ayrshire	1	6	305	5,455·0	241·91
Red Poll	1	17	274	5,589·3	227·15
Guernsey	Not represented				
Shorthorn	1	3	242	6,800·2	250·92
Totals and averages	175*	1,753	287	6,726·9	326·32

* Total does not agree, since some breeders tested more than one breed.

—*Dairy Division.*

According to regulations gazetted on 8th January last, "no person shall have any bird-lime in his possession or sell or agree to sell or offer for sale or purchase or agree to offer to purchase any bird-lime; no person shall use bird-lime for the purpose of capturing or attempting to capture birds. Offenders against these regulations are liable to fines of £5 on summary conviction, £10 for a second offence, and £20 for any subsequent offence.

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dress all your seed with:—

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BAYER'S DRY SEED DRESSING

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SEASONAL NOTES.

THE FARM.

Some Aspects of Feed-provision in Sheep-farming.

Two features of sheep-farming are of particular practical importance at present.

In the first place the high ruling prices for sheep and for the main products in sheep-farming make it increasingly desirable both to lessen losses due to avoidable deaths in the flocks and to increase the returns from each unit of production; each sheep that dies now is a greater loss than was the death of a similar sheep in the recent past, and quite often each producing unit is associated with an increase in depreciation and in other items in the cost of production.

In the second place, it is well established that in stock-mortality, in lamb-production, and in wool-production much depends on the feeding of the sheep throughout the year, and particularly on the feeding during the winter and early spring months.

That there is a connection between the feeding of sheep and their disorders and diseases generally is understood, but quite often it seems to be understood in really an inadequate and hazy fashion that does not lead to the due measure of attention being given to the work with pastures and crops that brings about proper feeding. Hence some of the major instances in which there is relationship between the feeding and the troubles of sheep seem worth noting. For instance, ante-partum paralysis or "dopiness" of ewes is a nutritional disease definitely associated, as a rule, with ewes falling off in condition at the approach of lambing. The incidence of "bearing" trouble is considered often to be connected with the type of feed. Underfeeding at some period during pregnancy is commonly accepted as an important cause of premature births of lambs, of dead lambs in the womb, and of lambs dying or being weak or small at birth. Veterinary research tends to show that rickets is one of the causes of losses in hoggets during the winter and spring months, and so it is of practical significance that rickets can be produced experimentally by feeding a diet deficient in its content of minerals—*e.g.*, lime and phosphates. Nutritional measures form one of the first lines of defence against internal animal parasites. The value of good feeding in combating such parasites often is ignored in practice; drenching without good feeding is apt to give unsatisfactory results. Regarding this point the Director of the Live-stock Division, in the 1936 annual report of the Department of Agriculture, states,—

"In attacking the problem of internal parasites of sheep too much reliance must not be placed on the specific action of any anthelminthic agent whilst neglecting the maintenance of the lambs' strength by the provision of extra suitable supplementary feed. In this respect the feeding of chaff, oats, and good hay will be found to produce good results. The difficulty which is said to be experienced in getting hoggets to eat hay in the early winter might be overcome by educating them earlier to take it. . . . The benefits of such practice are indicated in seasons when through abnormal conditions the pasture . . . cannot be maintained in that short condition which provides the best sheep feed."

Incidentally it already has been indicated herein that feeding has a considerable influence on the percentage of lambs obtained. The ewe that inherits the capacity to produce twin lambs does not necessarily give birth to twin lambs; with unsuitable feeding or management she

may produce only one lamb or none. Only under proper feeding and management can she produce the two lambs. Further, feeding affects the fertility of sheep—*i.e.*, their ability to produce living, healthy offspring, which, alas, often differs substantially from their fecundity. The number of lambs to be produced is determined at the time of mating, and subsequent feeding does not affect this number, but it may greatly affect how many of the total lambs produced are live and healthy lambs.

Apart altogether from diseases and disorders of sheep, feeding may influence the production of fat lambs and of wool. That the direct influence of feeding in fat-lamb production may be substantial has been indicated strikingly by work of Canterbury Agricultural College. In this work it was found that a difference in feeding not especially great was correlated with a difference in the weights of lambs at birth. The lambs of one mob averaged 9·7 lb. whereas those of another mob not fed so well averaged 7·7 lb. The true significance of this difference is shown from the relationship between the weight at birth of lambs and their subsequent development. In the work under consideration, lambs 6 lb. to 7 lb. weight at birth made an average increase in live-weight equivalent to 20 lb. in fifty days, while lambs of 9 lb. to 10 lb. and lambs of over 13 lb. live-weight at birth made increases of 26 lb. and 32 lb. respectively. Expressed in another way the largest lambs grew 60 per cent. more rapidly and the lambs intermediate in size 30 per cent. more rapidly than the smallest at birth of the lambs being considered. In conjunction with this should be taken into account the further fact that increased rapidity in growth begets economy in the quantity of feed consumed. This is rather well illustrated by the following data which make clear the contrast between the position relative to lambs light at birth and that relative to lambs heavy at birth: only two out of every five of the light lambs were fattened by 1st March, and only one out of ten was fattened off the mother, while all the lambs heavy at birth were fattened by 1st March, and two out of every three of them were fattened off the mother.

The foregoing statements form a serious indictment of inadequate feeding in sheep-farming; in short, an attempt has been made to indicate that poor feeding frequently is connected causally with diseases and disorders in the flocks, and that, apart from this, parsimony in feeding brings about readily a low standard of efficiency in the conversion of feed into flesh.

All this leads up to the matter of outstanding importance: in sheep-farming a weakness that is both widespread and grave generally rather than slight is poor feeding of the flocks in winter and early spring. The weakness probably would be lessened rapidly if it were more spectacular. But it does not altogether "strike the eye"; it is an insidious rather than an open weakness; typically it results in a somewhat heavier mortality in ewes, a decrease in twin births, an increase in lambs dead at or shortly after birth, a heavier consumption of feed to reach slaughter stage of lambs, and a bigger "tail-end" of lambs requiring feeding on rape or other special crop. Possibly no one of these by itself is really serious, but, taken together, they may have an influence great enough to make the difference between success and failure.

Current Measures to strengthen Feed Position in Winter and Spring.

The practical question of current importance is what may now be done towards remedying the common weakness. Foremost of the measures suitable for this purpose is phosphatic top-dressing in late summer or autumn.

Top-dressing.—Phosphatic top-dressing has been found to give results financially attractive on sheep-farms over a wide range of conditions of

soil and climate, including not only farms in districts of relatively heavy rainfall, particularly in the North Island, but also ones in districts of somewhat low rainfall on the eastern side of both the North Island and the South Island. In all cases in which it is fitting to sow truly perennial strains of such species as rye-grass, cocksfoot, white clover, and red clover, and in which such strains have been sown recently enough not to have been replaced already by inferior pasture species or by weeds, then profitable results may be counted upon from phosphatic top-dressing. In short, swards which contain a fairly substantial number of plants of the better pasture species may be expected generally to respond profitably to phosphatic top-dressing. Even though these plants of the better species are small and possibly far from prominent in the sward, they serve as a valuable foundation upon which to build a sward in which ultimately they tend to become dominant as the level of fertility is raised by successive phosphatic top-dressing and its associated beneficial results, such as the strengthening of the nitrogen content of the soil by clovers invigorated directly by the phosphates.

Replacement of Inferior Swards.—When swards are wholly or almost wholly lacking in plants of the better pasture species, the position is not so straightforward. Usually in the case of arable land it is advisable to break up such inferior swards and to replace them by ones containing a better foundation for good response to phosphates. Underlying this is the view that phosphates are likely to be more profitable when stimulating such species as rye-grass, cocksfoot, white clover, and subterranean clover than when stimulating such plants as brown-top, suckling clover, and even weeds. During recent years the economic soundness of ploughing inferior swards and replacing them by ones rich in such species as rye-grass, &c., already mentioned has been well demonstrated on sheep-farms in Canterbury and Hawke's Bay, as well as in other districts in which there is longer and more extensive knowledge that phosphatic top-dressing is profitable under the conditions prevailing.

Sward-improvement by Surface-sowing of Seed.—Sometimes, and this most usually because of the rough or broken nature of the land-surface, it is not practicable to plough inferior pastures and replace them by better ones; sometimes it is practicable but not economically attractive to do so, as in the case of light or dry soils in eastern districts of both Islands. In both of these sets of circumstances the possibility of strengthening of poor swards by the surface-sowing of suitable species, and especially of subterranean clover, should be examined. Some of the available experience relative to the use of subterranean clover for this purpose is given in the January, 1937, issue of this *Journal*. The use of subterranean clover in such circumstances is an application of the fact that subterranean clover often enables phosphatic top-dressing to be exploited on country where it would not be economic without subterranean clover.

At times, in top-dressing sheep country, it pays to supplement phosphates by other top-dressing materials, but phosphatic fertilizers may be looked upon as the basis of any top-dressing programme. Specific guidance about the top-dressing of pastures is obtainable from district officers of the Fields Division.

Special Arable Crops.—Sheep-farmers now also may valuably improve the position in respect to feed for winter and spring by growing suitable special crops, the culture of which has been dealt with in these notes in the two issues of the *Journal* preceding this, and is referred to subsequently herein.

Work with Special Crops.

The proper growing of forage crops sown in late summer or early autumn may serve valuably to provide, later on, feed which is much needed. Land from which such crops as oats, wheat, maize, millet, soft turnips, or

rape have been removed recently, if sown immediately in temporary pastures, or cereals, may be expected to strengthen appreciably the feed position in winter and in spring. If the land to be sown in such crops is so hard as to make satisfactory skim-ploughing impracticable, then cultivation with disks set with plenty of " cut " frequently will serve satisfactorily as an alternative to the skim-ploughing. In preparing for such crops it is not necessary to reduce the surface-layer of the soil to a fine condition. In fact, the presence of clods in the surface soil may be an advantage by obviating the caking of the soil that at times is brought about by rain beating on soil of a fine surface. These crops, and especially the temporary pasture, should be sown with as little delay as possible. They serve well, not only for sheep and cattle, but also for pigs: they become available when the feed directly available from the pastures is likely to be harmfully scant.

Every year areas of maize and of millet intended for green-feed are allowed to become too woody or are cut down by frosts. It is preferable to utilize such crops earlier and to use the land thereby rendered vacant in growing the fall-sown special crops mentioned just previously. Maize or millet that cannot be used advantageously as green-feed should be turned into silage provided sufficient is available to enable this to be done without the unduly high proportion of waste that is unavoidable in making small quantities of silage.

Often during March a cut of hay or green-feed is available from fields of lucerne. After such a cut, if weeds call for attention and if the conditions are dry, it is likely to be advantageous to give the crop a stroke of tine harrows or other suitable harrows possessing teeth with the fine points needed to avoid undue injury to the lucerne plants. Relative to such work it should be kept in mind that at times more harm than good has been done by cultivation of lucerne. Cultivation, unless a fairly prolonged spell of subsequent dry conditions can be counted upon, is likely at its best to be merely futile, while repetition of cultivation, which to destroy weeds has to be so severe that it also destroys some of the lucerne-plants, inevitably leads to an undesirably weak open " stand " of lucerne. Generally liberal manuring, the refraining from grazing, and the mowing of the crop at the proper stage are preferable to surface tillage as means of controlling weed-invasion of lucerne.

General Considerations regarding Pasture Establishment.

At the time of writing the number of samples of the 1937 harvest which have been tested is not great enough to indicate definitely the standard of the whole new seed-crop, but there is evidence that the germination-capacity of the seed will vary so greatly as to make it distinctly advisable to purchase pasture seeds on the basis of guaranteed germination-capacity.

Each successive year adds to the extensive evidence from farms of the superiority of certain strains of pasture species over other strains which are in commerce. The only assured way of obtaining the superior strains is the purchase of certified seed. Certified seed embraces a " commercial grade " of seed as well as the " permanent pasture " and " Mother " grades of seed with which farmers and merchants have had longer acquaintance. The " commercial " grade of seed normally is less costly than the other grades when all are of corresponding germination-capacity and purity. Further, the commercial grade of seed is eminently suited for a wide range of use. Full particulars about the different grades of certified seed are available from district officers of the Fields Division.

Top-dressing at or about the time of sowing pasture-seed mixtures often greatly assists in bringing about vigorous successful establishment. It is well to top-dress young pastures early, in time to prevent deterioration, rather than to find it necessary to apply fertilizer later in an endeavour to build up pasture which has deteriorated.

A common cause of unnecessarily and regrettably poor results in pasture establishment is the sowing of the seed at too late a date in the fall of the year. March sowings widely are to be recommended.

—*R. P. Connell, Fields Division, Palmerston North.*

THE ORCHARD.

Spraying.

For the control of codling moth and leaf-roller caterpillar in mid-season and late varieties of fruit, it still is necessary in many localities to continue spraying with arsenate of lead, at the rate of 1½ lb. to 100 gallons of water. All codling-infected fruits should be picked and destroyed regularly.

At this period of the year conditions are frequently favourable for the development of black-spot, and, therefore, a careful watch should be kept in clean orchards to detect the first indications of the appearance of this disease. In some localities this late infection often appears between the middle of February and the third week in March. Apply lime-sulphur (polysulphide content 15 per cent.) 1–180. When red mite or apple-leaf hopper are in evidence add nicotine sulphate 40 per cent., 1–800, or spray with summer-oil (1–80) two applications. An interval of from seven to ten days between the applications is desirable. At least fourteen days should be allowed to elapse before applying summer-oil following a sulphur spray.

Stone-fruit affected with any fungous disease should be sprayed, as soon as the fruit is gathered, with Bordeaux mixture 3–4–50. Brown-rot-infected fruit should not be allowed to be about the ground, but should be gathered and destroyed.

Drainage.

As opportunity offers, the drainage of heavy retentive soils should be attended to, as badly drained soil is not profitable orchard land. In well-drained land the soil is more congenial for the roots of the trees in the spring and during wet seasons than is the case in wet cold undrained land. Where drainage is necessary, it should not be put off for another year, but should be attended to as soon as possible.

Drainage allows the land to be worked earlier in the spring, makes it easier to work down to a fine tilth, and also prevents the souring of the soil. Tile drains, though more expensive, are the most permanent type of drain and give the best results in the orchard. The diameter of tiles for main drains should be at least 4 in. Soft boggy places in an orchard are often caused through seepage of water from a higher level, and in such cases a cross-drain located above the orchard and of sufficient depth usually cuts off the seepage water. After draining the land it should be well limed in the autumn or early winter. Existing open drains should be cleaned out, and the outlets to pipe-drains cleared so as to let the water pass freely away. Broken pipes should be replaced with new ones.

Budding.

Budding may still be practised on trees in which the sap is flowing freely.

Harvesting.

Mid-season varieties of stone and pip fruits are at or are nearing the stage of maturity when they are in a fit condition for picking for the respective markets or for storage. Picking and handling of fruit is a phase of orchard-work which requires much skill. The percentage of loss and wastage due to bruises and skin punctures caused at picking and in the subsequent handlings is much greater than it should be, and is striking evidence of the need of greater care in handling the fruit. A fact that should not be lost sight of is that the product of the year's work is being handled. A satisfactory realization is largely dependent on the condition in which

the fruit reaches the market. Damaged fruit frequently opens up in a very unsatisfactory condition, with dark ugly bruises, with skin punctures, and frequently is badly decayed. Damaged fruit should be disposed of with as little delay as possible, and should not be placed in storage.

Grading and Packing.

There is a good demand for well-graded and well-packed fruit. The fruit-merchants, the retailers, and the consumers seek the best fruit, and there is an ever-increasing inquiry for this quality of fruit put up in a uniform manner. During the period of "gluts" well graded and packed consignments have always been disposed of at a satisfactory figure, while, alongside, less carefully graded and packed consignments have not attracted buyers when offered at very low prices.

Growers are known to the regular buyers by their pack. Fruit-merchants have no difficulty in selling certain growers' fruit which is often bespoken at the highest ruling price before the fruit is delivered at the market. Buyers desire to obtain these well-graded consignments, while large quantities of fruit badly graded and packed though quoted at a much lower price are stacked in the rooms.

A conscientious packer is one of the most valuable workers in the cycle of duties associated with the assembling of fruit for distribution. If keen, he will readily note any variation in the grade standard of the fruit passed on from the sorters and draw the shed-manager's attention to it. On the other hand, the ultra-fast packer is so absorbed in his record-breaking effort that this precludes the possibility of much attention being given to standards, and, further, neatness and attractiveness also tend to be sacrificed. It must be apparent that only the highest quality in the different standards can effectively command attention to-day, and all adverse factors require to be eliminated.

Regarding the bulge necessary, with thin flexible top and bottom case-timber, fruit is not likely to suffer injury to a serious extent, provided the bulge is built into the pack. This is to say, fruit packed high towards the centre of the case does not suffer, neither does that towards the ends, providing allowance is made in the pack for the latter to press down readily to a level with the end boards. The purpose of the flexible top and bottom boards is to take care satisfactorily of the contents of a case packed in this way. Packers should be instructed to build the bulge in the case during the process of packing, and not simply fill the case with the required number of apples and leave the bulge to the lidding-press and to chance. The process of building in the bulge is quite simple, and may be accomplished by placing one hand on top of the other and pressing into their respective pockets the apples at either end and sides of the case (say, after the second layer has been placed in position), thus causing the pack to "pyramid" or bulge in the centre. This operation takes very little time, and saves considerable loss by bruising and cutting the fruit at either end or side of the case while on the lidding-press.

—B. G. Goodwin, Orchard Instructor, Christchurch.

Citrus Culture.

Cover-crops: Those who have not yet sown their cover-crops should do so without further delay, so that they may secure the benefit of the good autumn growing-conditions. Much depends upon the weather following the sowing of the seed. In most citrus districts, even if January has been dry, a break in the weather occurs sometime in February, and this, together with the warmth in the soil, gives the cover-crop a good start. For several years the Department of Agriculture supplied cultures for lucerne, and by this means this crop has been successfully grown on ground which otherwise would have proved difficult for its establishment. The Department of Scientific and Industrial Research has decided this year to inaugurate a similar service for the supply of cultures suitable for blue lupins and peas. In view of the success which has attended field trials of

these cultures, those who have not had good strikes with these crops in the past may well try inoculation. The cost of inoculum for each 200 lb. of lupin-seed is 2s. 6d. Those desiring to participate in this service should get into touch with the local Instructor in Agriculture at least ten days before they intend to sow the seed.

Picking: Although the crop of a suitable size for picking is light at present, growers should resist the tendency to lengthen the interval between each picking, even though the cost of harvesting becomes greater. The market-values are higher at this time of the year, and every effort should be made not only to participate in the increased prices, but also to keep up the supply of good locally grown lemons so that shortage does not necessitate importation. During the period the picking is light an opportunity should be taken to overhaul the equipment of the picking gangs. The clippers should be kept sharpened and should be examined to see that there is no excessive slack between the blades. Picking bags should be repaired if there are any holes which allow fruit to fall out and be damaged. Now that the orchard-boxes are not being used so continuously, time should be found for an overhaul of these also. Protruding nails—a source of many an injury—should be removed, and rough splinters of wood should also be dealt with. In cases where pieces of the bottoms or sides have split and fallen away so that the lemons protrude beyond the bounds of the case or rest on sharp edges, the damaged pieces should be removed and new boards fitted to make the cases again serviceable. The boxes may be strengthened by means of a wire around each end tightly applied and made secure by means of light staples driven in, say, two on each side. One of the wire-tying machines is very serviceable for this job. The cases should be disinfected from time to time, a suitable dip being a 40 per cent. formalin solution used at a strength of 1 part by volume to 120 parts of water. While this can be most conveniently done at a central curing-shed, growers should make a point of seeing that this treatment of the boxes is not neglected. Instances have not infrequently occurred in which boxes arrive back at the orchard containing one or two blue or green mould-infected fruit firmly attached to the inside of a case. Obviously growers placing fruit in cases in this condition do not fully realize the necessity for orchard sanitation.

Manuring: The question of autumn manuring of citrus trees is one about which there has been considerable controversy; but space does not permit a review of the position, nor would this serve any useful purpose. Many of the approved manures for citrus trees are of slow action. Because of this, a number of successful growers make only one annual dressing of fertilizers, generally in the spring. The best position is one in which there is an ample supply of fertilizers in the soil which can be drawn upon by the trees as required and when soil conditions permit. The annual dressing of manures should be looked upon as a replacement of what the trees have taken from the soil during the previous year. If the quickly acting forms of nitrogen, such as sulphate of ammonia and nitrate of soda, are used, it is desirable to make two applications annually, one in early spring and the other in early autumn—February–March—no later. Some growers contend that the application of nitrogen in the autumn is often the cause of frost damage, owing to the fact that the trees produce sappy growth which has not had time to harden off before the advent of frost. While there may be some ground for this contention, a point which is often overlooked is that if good growing-conditions continue late into the autumn and then a change to winter temperatures comes suddenly, damage occurs irrespective of manuring.

Disease Control: The February – March period is one in which sprays usually should be applied. Scale insects, where present, require attention according to the programme (summer-oil 1–33) outlined in December notes. The work should be done thoroughly. On inspection immediately after spraying, a tree should show no dry spots on trunk, limbs, fruit, or foliage.

The temperatures during February and March still are favourable for the spread and development of verrucosis, provided other conditions are suitable. Where there is a further blossoming and setting of young fruit, an application of Bordeaux 3–4–50 should be made.

Budding may be carried out now, if desired, provided there is sufficient sap flowing to cause the bark to lift easily. If conditions are suitable, the buds take readily, but growth is not made until the spring. Autumn buds develop ahead of those worked in the following spring.

A. R. Grainger, Orchard Instructor, Tauranga.

POULTRY-KEEPING.

Systematic Culling.

As to cull means to separate anything from the rest because of inferiority the importance of the work or art of culling to the poultry-keeper cannot be overestimated. The process may be said to be a continuous one with the successful man. It commences when eggs are being set, and is continued with his birds throughout the year. To start with, only eggs of a good size, shape, colour, and texture of shell should be set. In this connection it may be mentioned that three times each year a certain number of the eggs laid by each bird competing at our local laying competitions are judged by officers of this Department for shape, colour, size, and texture of shell, and prizes are awarded accordingly. Though some owners take a keen interest in these judgings, results seem to indicate that many breeders fail to appreciate the importance of this matter.

If a comparison was made each year of the points awarded for size of eggs and texture of shells, it should serve as a very useful guide as to how the vitality and constitution of one's strain is being maintained. If smaller eggs are being produced and less points are gradually being awarded for texture of shell, it should be taken as a warning that the body is gradually getting worn out, and steps should be taken to correct matters. It must be remembered that the hen is not a machine, so when nature sends out these first distress signals every breeder would be wise if he took them as warnings that the exertion and drain of sustained and forced egg-production has been carried far enough, that greater care is needed in the selection of breeding-stock, and that some fresh blood is required.

A person desiring to purchase a bird or birds from a laying competition would be well advised to ascertain the number of points awarded to their eggs, especially for size and texture of shell.

When chickens are hatched, only those showing strength and vitality should be placed under the brooders, while it is better to destroy those showing any weakness.

As the young stock grow those showing want of constitution, poor development, or any deformity should be eliminated. Where such a systematic culling is practised it will be found, in some cases, that when it comes to the end of the first laying-season up to one-third or even more of the pullets hatched have been culled, but the poultry-keeper who adopts such a system gets the very best return from his plant, and maintains a good strong vigorous flock which is seldom attacked with any epidemic or outbreak of disease. There are, however, many poultry-keepers who fail to see the necessity for such hard culling, and some who from want of better knowledge or perhaps lack of interest in their poultry do not practice culling.

It is the desire of the Department to assist poultry-keepers in keeping up the quality of their birds, and if those requiring advice make application to the Department arrangements will be made, if possible, for an officer to visit their farms and give a demonstration. Undoubtedly the best way to keep a flock on a good paying basis is to adopt a regular system of culling throughout the twelve months, but, if this is not convenient, at

least once a year a really systematic handling and examination of all birds should take place, and about the best time to do this work is during February, or just before many good birds go into the moult.

In order to make the best job of culling a flock the operator must know something about the birds he is to handle, in order that certain points may be given due consideration. For instance, if birds have been recently moved from other pens, underfed, or mismanaged in any way, one must be very careful in applying the usual culling-tests.

The age of the birds should be known, and much more satisfactory work is likely to be done when the one-and-a-half-year-old birds are kept in different pens from those of the older birds, but, where this is not possible, the different ages should be marked so that the younger birds can be dealt with first.

Generally speaking, one-and-a-half-year-old hens that began to lay last February or March will not lay as late into this autumn as the older birds that did not start laying until July or August last.

The usual matters to take into consideration when a flock is to be culled are—First, the early moulter, for, as a rule, the first birds of a given age to moult are those of weaker constitution and should be culled. If one has plenty of room to accommodate the stock it is generally safe to say that any one-and-a-half-year-old hens that are still laying and have not started to moult by the middle of February will pay to keep for a further year. Exceptionally heavy hens for the breed they represent are usually poor producers, and can with safety be put out. Birds showing want of vigour and vitality should be culled, and as physical activity is one of the chief characteristics of health it may be said that sluggish birds and those that spend a great deal of their time on the perches are of poor vitality, and should be discarded, together with those very light and poor in condition.

Age to keep.

A great number of hens are kept long after the age when they have the physical ability to produce sufficient eggs to pay for their upkeep. This is more noticeable amongst many farm flocks and where poultry are kept, but where there is a lack of interest taken in the birds.

Most hens when they reach the age of about two and a half years have come to the time when they are no longer profitable commercial egg-producers, and therefore should be sold. However, if the poultry-keeper is breeding his own stock and some of the two-and-a-half-year-old hens are of exceptional breed type and still show vitality, they should most certainly be retained and specially marked for the breeding pen, for experience has shown that such hens are amongst the most valuable breeders.

As there is no way of definitely telling the age of a hen, all birds should be leg-banded. If all pullets were leg-banded, say, on the left leg just before they come on to lay, and if a second ring was placed on the right leg at the end of the first laying-season, there would be no difficulty in picking out the different ages and culling them when their term of usefulness has ended.

The Late-hatched Pullets.

Although the loss occasioned from keeping hens that have passed the age of usefulness is very considerable, it is safe to say that the greatest weakness in the industry to-day is the hatching of late stock and the lack of proper culling of growing pullets. It is true that to be able to cull successfully a flock of healthy growing pullets calls for extra skill and experience, but on many farms no young stock are culled until the autumn of the year, with the result that many weedy pullets that never pay their way and are a danger on the plant are kept. Pullets hatched much after the end of October seldom start laying until well into the winter, or until early spring, and as eggs are then getting cheap such late stock have not sufficient time before the moulting-period begins in February or March to produce enough eggs to repay what they have cost.

It is safe to say that it pays well to cull up to 10 per cent. of well-reared pullets before they start laying, but with poorly reared, weedy, or late pullets the culling should be much harder.

Body Type.

A bird to be a good layer must have a well-balanced body showing ample capacity, which is estimated by the distance from the pelvic bones to the end of the breast bones, and also by the length and width of back—in other words, by the cubical content of the body frame.

The chief characteristics of a cull are—Abdomen small and tucked up, but if large it feels coarse with layers of fat underneath the skin. The comb is usually small, more or less hard, and cold. Head coarse or small and weedy; eyes small, listless, and sunken. The pelvic bones are usually thick, coarse, and stiff, with less than two fingers' width apart. Vent dry, small, and puckered.

Over-fat Leghorns or other yellow-legged breeds can usually be picked out by their yellow legs and beaks at this time of year. The continuous striving for increased egg-production is likely to cost the industry dearly unless every effort is made to maintain vigour and constitution; even to-day some poultry-keepers are finding that financial success depends largely upon their being able to combat disease. No producer can afford to overlook or underestimate the best means of protection, which is to master the art of and adopt systematic culling throughout the year.

C. J. C. Cussen, Chief Poultry Instructor, Wellington.

THE APIARY.

Final Extracting.

BEFORE the last of the surplus honey is taken a careful examination of the colonies should be made in order to ascertain the amount of stores available for wintering the bees. Too often beekeepers err in extracting too completely, and feeding has to be resorted to at a later period to make up the amount required to prevent starvation. It takes 30 lb. of honey to winter a colony successfully, and if this amount is increased to 40 lb. there is less likelihood of the bees being short in the spring, while the beekeepers also are saved a great deal of anxiety and endless trouble in the way of feeding.

Where extracting has been delayed for any reason, it is advisable to use great caution in removing the honey. The combs should be removed as expeditiously as possible, and care should be exercised not to incite the bees to rob by keeping the hives open longer than it is necessary to remove the surplus. A hasty examination of the brood-chamber should be made if it is found that the bees have not filled the combs in the lower story with honey. If empty or partly filled combs are found, it is highly important that they be replaced with good combs of honey from the super. On no account attempt to extract any honey from the brood-chamber Do not leave combs lying about or expose vessels that have contained honey. Unless caution is exercised in regard to these details, when the final extracting is being done the beekeeper is more than likely to start the bees robbing in a wholesale manner.

Bee-escapes.

For removing honey late in the season the beekeeper may find it necessary to bring into use bee-escapes. These escapes enable the honey to be removed without causing any disturbance. By the employment of the Porter bee-escape there is less likelihood of causing robbing, with its attendant evils. More especially are the escapes found advantageous when removing section honey from the hive. There is far more risk in removing comb honey than extracted honey. When the colony is disturbed the bees at once start to fill their sacs, and often the cappings of the sections are punctured in order to secure a supply of honey. The damage to the

cappings of sections is unsightly, and causes the honey to "leak" after removal from the hive. The escapes are fitted to a board of the exact dimensions of the hive in use. In inserting the board gently prize up the super from the brood-chamber and insert the board. A puff of smoke suffices to control the bees while the operation is being performed. If this is done late in the afternoon the bees pass through the escape during the night to the brood-nest, and are unable to return. In the morning the supers may be removed, when practically no bees will be left in the super.

A word of caution to those who formerly have not used the escapes: Should there be brood in the super-combs, the bees do not leave, and the escapes do not prove effective in ridding the supers. Over and over again many beginners complain that they cannot get the bees to leave the supers when using escapes, but the reason lies in the fact that no examination had been made to ascertain beforehand whether the super contained honey only.

Uniting Colonies.

In the autumn, work requiring attention is the examination of the colonies for the purpose of ascertaining if each possesses a laying queen, and of noting those that are too weak to survive the winter. It is advisable to unite a weak colony or one without a queen with a stronger colony to save the bees. On no account should an attempt be made to winter weak hives, as they are likely to get robbed, and this may cause the bees to start robbing when everything in the apiary should be quiet. A simple method of uniting may be practised by placing the weaker hive on top of a stronger one, and placing a sheet of newspaper between the two hive-bodies. In the course of a few days the bees of the weaker colony make their way through the paper and unite peaceably with the bees in the stronger hive. The surplus combs may subsequently be removed and reserved for spring feeding if required. It is advantageous to destroy the queen in the weak hive prior to uniting.

Robbing.

At the close of the honey-flow the beekeeper should guard persistently against robbing. Robbing, the result of carelessness, once started is exceedingly hard to check. As previously mentioned, neither honey, sugar-syrup, nor anything that the bees can take should be exposed. If wet combs have to be returned to the hives for the bees to clean, postpone this operation until late in the day, when robbing is not likely to start. See that the honey-house is bee-proof, and that all combs and vessels containing honey are removed to a place of safety. Contract all hive-entrances, and especially guard against hives being open in a way that they can be attacked by robbers. All operations must be carried out quickly. If robbing has started it is better to postpone all outside work until the apiary is quiet again than to risk extending the trouble by opening the hives. Should a colony be attacked, contract the entrance and pile wet grass in front of the hive. This usually cures mild cases of robbing, but where a colony has been overpowered by the robbers it should be closed altogether.

E. A. Earp, Senior Apiary Instructor, Wellington.

HORTICULTURE.

Vegetable Crops.

THE full enjoyment and economical use of many vegetables depend not only on a wise selection of varieties and careful culture; sound consideration must be given to harvesting and storage if there is to be no loss in quantity and quality and the stocks are to be available over a maximum period. Under most local conditions such crops as celery, parsnips, salsify, artichokes, autumn-sown carrots, and beet may be left in the ground during winter, with quite satisfactory results, and lifted in dry weather as required

until about the month of August, when growth is about to recommence. They must then be lifted and stored where the conditions are cold, well ventilated, and not too dry. Main-crop carrots maturing about the month of April split if left in the ground, and become coarse and fibrous, as do main-crop beet maturing at that time. These should be lifted in fine weather as soon as they mature and given the storage conditions before mentioned.

A lean-to shed with a southerly aspect often is a suitable place, especially when shaded by plantation trees and having ample means for ventilation in the higher part of the roof. Such a place is also suitable for potatoes stored in bins, sacks, or boxes, if it is clean, well drained, and dark, but not so dry as to cause the tubers to shrivel. Considerable losses from decay occur if the stocks are contaminated by the presence of decayed tubers or waste carried over from a previous season in the store or its vicinity. This can readily be avoided by the methodical disposal of decayed waste at all times, and a thorough annual clean-up of the store, which may very well include a careful spraying of the interior with a reliable fungicide. Losses from decay may also occur through infection caused by decayed tubers overlooked when bagging in the field; or a good crop, to all appearances sound, may be placed in the store and in a month may be in a useless condition due to the attack of the potato-moth. This attack, which is most likely to occur in warm, dry localities and seasons, may be avoided by picking up and bagging the tubers the same day as they are dug and placing them in a clean store. In this way the night-flying, egg-laying moth is unable to deposit on the tubers those eggs which later hatch out into caterpillar larvae which tunnel the flesh and make tubers an early prey to organisms of decay. Doubtful stocks should be picked over after a month or two in storage, and if the infection is fairly extensive they should be used as soon as possible. Large quantities stacked in a compact manner heat and sprout, especially in warm districts, and in a store where attention to ventilation is neglected. In such localities they may be stored satisfactorily in slatted bins to a depth not exceeding 3 ft. or 4 ft., but in colder districts 6 ft. may be a maximum depth, as long as good ventilation is provided, except when there is danger of injury through frost. Where stocks are large and storage accommodation limited, a quantity for late use may be satisfactorily held in a pit or clamp outside if the tubers are quite sound. For this purpose a well-drained, cool position should be chosen, and the pit made not more than 5 ft. or 6 ft. wide, and the tubers piled as high as possible. To prevent heating the pit should not be completely sealed for the first few weeks; during that period the soil casing over the straw or fern covering should only be carried up to within a foot of the ridge. If these conditions are observed and the potato crop is carefully dug in fine weather as soon as ripe, and allowed to harden off for a few hours before gathering, it will be used to best advantage.

The onion crop requires somewhat similar storage conditions, the chief difference being a drier atmosphere. The bulbs should be lifted as soon as ripe (this is of especial importance in districts inclined to be humid and warm), placed in windrows consisting of five or six rows of bulbs, until the tops wither completely. If wet weather is experienced the windrows are turned over by the use of a wooden rake. When thoroughly dry the bulbs are trimmed with shears and bagged, or placed in slatted crates, and stacked in an open shed for a few weeks to cure thoroughly before storage or shipping. When cured the bulbs are cleaned by taking away the dry outer scales. Bulbs which have thick necks or which are damaged are removed, and the remainder are graded to size. They will then store satisfactorily if placed in a comparatively dry atmosphere that is cool, with an even temperature and given thorough ventilation at all times, except in wet or humid weather. If in slatted boxes they are stacked, like fruit, with 1 in. space between tiers and rows to permit of circulation of the air; or they may be spread 6 in. or 8 in. deep on slatted shelves; or small quantities may be "strung" and hung in a dry airy place in the old-fashioned manner. This latter

method is particularly suitable for shallots held over for planting another season. All bulbs of this class deteriorate very quickly in a close atmosphere.

Vegetable marrows are best used in a green state when of a suitable size, but pumpkins, and what are known in America as winter-squash—such as the Hubbard varieties—should not be harvested until thoroughly ripe, but before they have been frosted. They are cut with a portion of the stem attached and left in the field to mature before carting. They must be handled and carted with care, as it is easy to injure them seriously at this stage. When they are stored in a warm, dry, airy place for a few weeks their shells harden and they then can stand somewhat lower temperatures and rougher handling if that is necessary.

In the warmer districts, especially where there is also a heavy annual rainfall, the ordinary late potato crop is rather difficult, but the sweet potato, or kumara, generally grows well. For this and other reasons it is increasing in popularity in such areas. While the crop is best left growing as late as possible, it must be lifted before there is any frost, or the tubers immediately under the crown are liable to injury. If frost kills the vines the kumaras should be dug immediately, as decay sets in on the dead vines and may pass down to the tubers. Digging must be done with the greatest care, as the slightest damage at this stage prevents the tubers keeping, and storage losses are due chiefly to faulty handling before curing. Curing, which occupies about a week, is usually done by gathering the tubers into heaps and covering them with sacks every night, to dry them thoroughly before storage in a warm dry, chamber that can be ventilated in warm weather. Small quantities may be kept successfully by storing in sand provided it is perfectly dry.

In the southern States of America, where sweet potatoes are grown on a commercial scale, the tubers are stored in crates, stacked to allow ample ventilation and to enable the air to circulate through them, in chambers that are heated to a temperature of about 80° F. for the first fortnight or so of the storage period. When the roots are well dried the temperature is allowed to drop to 55°, and is held there for the rest of the storage period, giving ventilation freely when the weather permits.

To provide young spring onions at that season, when salads are so much in demand, a sowing should be made during the month of March—towards the end in the warmer districts. For this purpose the Rocca or Tripoli types are most suitable, owing to their mild flavour and tender flesh. In warm districts with a considerable annual rainfall the sowing should be extended to also provide young plants for setting out in early spring that ripen their bulbs about the month of January, which is more satisfactory under such conditions than sowing the main crop in early spring as is done in the drier districts. The land selected for the seed-bed should be well drained and thoroughly cleaned of weeds by shallow cultivation for some time before sowing.

Where the tomato crop is of considerable importance it sometimes is advisable to select the seed under local conditions, so that while the fruit is of a type suited to one's requirements the plants are thoroughly acclimatized. Time and careful consideration should be given to the selection of plants from which seed is to be taken; they should be free from serious disease, of good constitution, and carrying crops that are as satisfactory as possible in regard to quantity and quality. Fruit that is likely to be coarse or small should be removed from the bunches and the remainder allowed to ripen naturally on the plants, which should be flagged to enable them to be readily recognized. When the tomatoes are ripe they should be cut open and the pulp dropped into a little water. The water containing this pulp should be placed in a warm place, and as soon as it commences to ferment it should be poured into a gravy-strainer and washed well under a tap of running water until clean seed only remains. The clean seed should be placed in a position where it dries quickly and well stirred frequently to

prevent seeds sticking together. If the seed is stored in tins or other air-tight containers, it is as well to redry it after a short period to make sure of its condition. It should then remain in good condition for five years at least. When conditions are favourable for a good seed-harvest a generous supply should be taken to provide against contingencies. Another method of saving tomato-seed is to scoop the seeds from the fruit and let it drop on to sand that is quite dry and has been passed through a fine sieve; the mixture should be well rubbed through the hands for some time and then spread to dry. When it is dry it should be rubbed again and sieved to remove the sand.

The Homestead Garden.

Where trees and shrubs for shelter or ornamental purposes are to be purchased a visit to the nurseries should now be made and the requirements carefully selected and ordered for delivery so soon as they are ready for removal, which will generally be towards the end of the month of May. They can then be planted at once with great advantage or they can be "heeled in" and so be ready for planting whenever the weather and other circumstances permit.

Most kinds of spring flowering bulbs are planted during the first four months of the new year, but the earlier this is done the better, so that they may be well rooted before winter sets in. Exceptions are hyacinths and tulips, which appreciate a period of warm storage, also anemones and ranunculus tubers; these are usually planted during the month of April, and are all partial to a soil well supplied with lime. Many plants of this class provide an early display of blossom of excellent quality with little labour, and so deserve every consideration. In addition to high culture in special beds, they may be planted in grass or shrubberies, where they will flourish for many years before requiring attention.

Established lawns may now be given any extra attention that is necessary, such as returfing worn places and loosening up hard places with a fork, or thoroughly raking the whole area, and, after cutting, sowing suitable grass-seeds before applying a light top-dressing composed of fine soil and manures. Where the lawns have been in constant use for games this attention is urgently needed, and should be commenced as soon as the playing-season is finished, so that the most may be made of the interval between seasons which is generally all too short for this purpose. A sharp look-out should be kept for insect pests. This is the season when damage may be done to lawns by the common earthworm when numerous, or the subterranean caterpillar (*Porina*) or grass-grub (*Odontria zealandica*). Damage is best avoided by giving the matter prompt attention so soon as the attack is perceived.

—*W. C. Hyde, Horticulturist, Wellington.*

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ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

FOOT TROUBLE IN DRAUGHT HORSES.

W. L. B., Waipara :—

A complaint that the draught horses have in their hooves here appears to be similar to thrush ; the feet have a septic discharge, sometimes from the cleft of the frog, and sometimes from the depressions at each side of the frog, and the discharge has an offensive smell. The complaint develops in front or back feet, and it recurs every three months or so.

The Live-stock Division :—

The symptoms you have described are caused by an inflamed condition of the membrane, which secretes the horn of the frog. Under these conditions this membrane forms weak and degraded horn of a cheese-like consistency, which readily liquifies under the action of moisture and produces the offensive discharge. For treatment you must first endeavour to keep the feet dry. Carefully remove any diseased or loose portions of the horn, then thoroughly work into the parts from which the discharge issues one of the following applications : (1) burnt alum, or (2) calomel, or (3) iodoform 1 part, eucalyptus oil 8 parts. If you wish to keep the horse at work the dressing should be packed in with cotton wool or tow, over which is smeared Stockholm tar in order to keep out the wet and dirt. Unless the discharge is profuse, the dressing may be left in place for two or three days.

CROP FOR LAND INFESTED WITH YARR.

F. M. R., Springfield :—

A paddock which was sown in turnips, partly owing to the wet season, was an almost complete failure, a weed which we know as yarr taking possession and going to seed. It is now proposed to lime the land with ½ ton of carbonate of lime per acre, and sow a smothering-crop to be later cut for silage. Would you suggest the most suitable crop to grow, the rainfall is 40 in., and we are 1,600 ft. above sea-level.

The Fields Division :—

A satisfactory result may be expected from sowing a mixture consisting of 2 bushels of oats and 1 bushel of Partridge peas or Scotch tares. Garton's and Algerian oats are both suitable for the purpose, but if a late spring sowing is anticipated the Garton variety, a rapid upright grower, is likely to be preferable. With quantities of 3 bushels per acre of the mixture suggested it is often an advantage to drill and cross drill the seed—that is to say, sow 1½ bushels each way, and 1 cwt. to 1½ cwt. of superphosphate per acre can usually be applied with profit to such crops.

KEEPING-QUALITY OF SPRAYING MATERIALS.

T. W., Otekaike :—

How long will the following materials keep without detriment : Bluestone in solution, lime in solution, Bordeaux mixture in solution, lime sulphur in solution, and most mixtures for stone and pip fruits.

The Horticulture Division :—

Stock solutions of bluestone and lime may be stored separately for long periods without deterioration. Other solutions and mixtures of orchard-spraying materials depreciate in various ways, some very quickly. They should be used the same day, and, better still, applied as soon as made, with the agitator working to keep all ingredients in suspension and thoroughly mixed, especially where large quantities are being used.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 3rd December, 1936, to 28th January, 1937, include the following of agricultural interest :—

No. 75460 : Sleigh ; C. J. Honore. No. 76205 : Threshing-apparatus ; Allis-Chambers Mfg. Co. No. 76939 : Teat-cup ; L. A. Sowerby. No. 74596 : Rabbit-poisoning ; K. G. McEwan. No. 74683 : Pump ; F. A. Stempa. No. 74886 : Casein product ; Albright and Wilson, Ltd. No. 75386 : Fruit-picking bag ; S. R. and A. R. F. Fisher. No. 75453 : Plough-share ; A. B. MacDonald. No. 75578 : Teat-cup ; A. J. Chinn. No. 75703 : Milking-machine ; L. R. and T. W. Greenslade. No. 76141 : Insecticide ; Assignees of S. C. Fulton. No. 76204 : Harvester-thresher ; Allis-Chambers Mfg. Co. No. 76214 : Manure-distributor ; J. H. Nitschke. No. 76947 : Shear-head ; Wolseley Sheep-shearing Machine Co., Ltd. No. 77014 : Fencing, barbed-wire ; H. A. Abbott. No. 77057 : Manure-distributor feeding-slot ; J. H. Nitschke. No. 74822 : Fencing-post clip ; W. Laird, H. M. Carruthers, and D. McL. Lewis. No. 75801 : Lawn-mower ; J. W. Johnson.

Copies of full specifications and drawings in respect of any of the above may be obtained from the Commissioner of Patents, Wellington, price, 1s. prepaid.

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WEATHER RECORDS: JANUARY, 1937.

Dominion Meteorological Office.

NOTES FOR JANUARY.

THOUGH the rainfall was below normal in parts of the South Island, the weather was generally humid, and January was a wet month, especially in the North Island. The humid conditions favoured the growth of pasture, which is still abundant, in many places indeed superabundant. Stock, consequently, are in good condition, and the milk-yield has been well maintained. Feed remains rather soft, however, and lambs have not fattened very well. The cool weather, too, has been rather unfavourable for crops of most kinds. Shearing, which had been held over in some districts by the wet weather, was still further delayed, and haymaking was interfered with. White butterflies have been rather more numerous again. Unusually low pressures prevailed throughout the month, which was more stormy and windy than most Januaries.

Rainfall.—The whole of the North Island, with the exception of parts of Taranaki, had more than the average rainfall. North Auckland had more than double, and between Hawke's Bay and the Bay of Plenty, also, it was very wet. In the South Island, though it was generally a wet month, the total falls were below normal in Nelson and parts of North Canterbury and Otago.

Temperatures were below normal over almost the whole country, the departure being generally about 2° F. Hastings and Hanmer Springs, however, were warmer than usual, doubtless owing to the Föhn effect in the strong westerly winds. About the middle of the month a few frosts were recorded, and snow fell to rather low levels on the mountains.

Sunshine was above normal at Wellington and in eastern districts of the South Island, but elsewhere was below it. Blenheim had 277·2 hours, Lake Tekapo 272·7, and Nelson 255·2.

Pressure Systems.—On the 1st a depression was passing away eastward, and the weather was still disturbed over the Dominion. Rain was widespread. Some heavy falls occurred on both coasts of the North Island, but particularly in the north-east.

On the 5th a vigorous disturbance came from the Tasman Sea, and a centre of low pressure moved from west of the Auckland Peninsula south-south-easterly across the North Island. Heavy rain was general.

Between the 9th and the 12th there was a series of westerly depressions which affected principally the South Island and southern portions of the North.

On the 14th a cyclonic depression, which had developed in the North Tasman Sea, moved southwards from near Norfolk Island across the North Island and finally filled up on the 16th. On the 14th to 15th easterly gales in the Auckland Province did considerable damage. Heavy rain was again general over the North Island, and some flooding occurred in North Auckland and southern Hawke's Bay. Dannevirke had 8·25 in. of rain on the 16th.

After a brief interval of anticyclonic weather, a series of very deep westerly depressions crossed the South Island between the 19th and 23rd. In the south the barometer fell below 29 in. Westerly gales were experienced in many places, and heavy rain fell in the west and south.

The last storm of the month began as a tropical cyclone in the northern New Hebrides and passed, a week later, in a south-easterly direction down the east coast of the Auckland Peninsula on the 29th and 30th. Strong easterly winds and heavy rain occurred in eastern and northern parts of the North Island. At the same time, a westerly depression passing in the south brought heavy rain to the west coast of the South Island.

RAINFALLS FOR JANUARY, 1937, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average January Fall.	Total Rainfall to Date.	Average Rainfall to Date.
			North Island.			
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	8·47	13	1·90	3·94	8·47	3·94
Russell	17·10	13	5·15	4·09	17·10	4·09
Whangarei	10·64	14	4·30	3·93	10·64	3·93
Auckland	4·41	18	1·58	2·97	4·41	2·97
Hamilton	5·28	16	1·61	3·57	5·28	3·57
Rotorua	..	..	..	4·18	..	4·18
Kawhia	..	..	..	3·55	..	3·55
New Plymouth ..	4·24	14	1·04	4·18	4·24	4·18
Riversdale, Inglewood ..	7·97	14	1·56	7·51	7·97	7·51
Whangamomona ..	5·20	11	1·57	5·58	5·20	5·58
Hawera	3·08	15	1·09	3·51	3·08	3·51
Tairua	..	..	..	3·66	..	3·66
Tauranga	5·38	17	1·67	4·03	5·38	4·03
Maraehako Station, Opotiki	10·43	10	4·70	3·59	10·43	3·59
Gisborne	5·15	10	1·67	2·72	5·15	2·72
Taupo	4·62	10	1·61	3·37	4·62	3·37
Napier	4·69	14	2·18	2·50	4·69	2·50
Hastings	3·01	12	1·75	1·93	3·01	1·93
Whakarara Station ..	6·29	9	1·20	..	6·29	..
Taihape	4·21	22	1·25	3·18	4·21	3·16
Masterton	4·14	12	1·65	2·56	4·14	2·56
Patea	4·07	17	0·87	3·59	4·07	3·59
Wanganui	3·23	11	1·30	2·83	3·23	2·83
Foxton	2·24	11	0·73	2·14	2·24	2·14
Wellington	3·18	12	1·26	2·89	3·18	2·89
			South Island.			
Westport	8·93	18	2·07	8·20	8·93	8·20
Greymouth	15·30	22	4·01	9·17	15·30	9·17
Hokitika	14·36	20	4·38	10·10	14·36	10·10
Ross	20·49	18	4·99	12·40	20·49	12·40
Arthurs Pass	20·25	17	3·71	14·12	20·25	14·12
Okuru, South Westland	14·52	10	3·00	12·59	14·52	12·59
Collingwood	9·43	17	2·96	6·71	9·43	6·71
Nelson	2·09	7	1·32	2·90	2·09	2·90
Spring Creek, Blenheim	3·65	9	2·00	2·22	3·65	6·22
Seddon	3·59	9	1·76	1·84	3·59	1·84
Hanmer Springs ..	2·14	15	0·36	3·95	2·14	3·95
Highfield, Waiau ..	1·09	8	0·29	2·98	1·09	2·98
Gore Bay	1·30	12	0·23	2·46	1·30	2·46
Christchurch	2·08	..	0·71	2·33	2·08	2·33
Timaru	3·70	10	1·20	2·39	3·70	2·39
Lambrook Station, Fairlie	3·48	11	0·81	2·43	3·48	2·43
Benmore Station, Clearburn	5·50	11	2·06	2·77	5·50	2·77
Oamaru	2·27	10	1·28	2·04	2·27	2·04
Queenstown	3·86	12	0·80	2·87	3·86	2·87
Clyde	1·60	10	0·49	1·85	1·60	1·85
Dunedin	3·31	16	0·96	3·41	3·31	3·41
Wendon	4·90	12	2·10	3·20	4·90	3·20
Balclutha	2·35	14	0·70	2·31	2·35	2·31
Invercargill	4·38	22	0·60	4·00	4·38	4·00
Puysegur Point ..	7·89	20	1·07	7·62	7·89	7·62
Half-moon Bay ..	7·21	20	1·15	4·82	7·21	4·82